UNITED STATES ARMY

MARCH 1969

AVIATION DIGEST

UNITED STATES ARMY AVIATION DIGEST

DIRECTOR OF ARMY AVIATION, ACSFOR
DEPARTMENT OF THE ARMY
BG Edwin L. Powell Jr.

COMMANDANT, U. S. ARMY AVIATION SCHOOL
MG Delk M. Oden

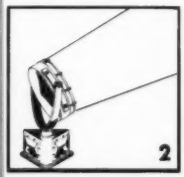
ASST COMDT, U. S. ARMY AVIATION SCHOOL
COL M. H. Parson

DIGEST EDITORIAL STAFF
LTC Robert E. Luckenbill, Chief
Richard K. Tierney, Editor
William H. Smith
John P. Jones
Marian Jones
Linda McGowan

GRAPHIC ART SUPPORT
Harold G. Linn
Harry A. Pickel
Dorothy L. Crowley
Angela A. Akin

DIRECTOR, U. S. ARMY BOARD FOR AVIATION
ACCIDENT RESEARCH
COL Russell P. Bonasso

USABAAR PUBLICATIONS AND GRAPHICS DIV
Pierce L. Wiggin, Chief
William E. Carter
Jack DeLoney
Ted Kontos
Charles Mabius
Patsy Thompson
Mary W. Windham



MARCH 1969 VOLUME 15 NUMBER 3

VIEWS FROM READERS 1
ARMY AVIATION'S FUTURE 2
LTG Harry W. O. Kinnard
INADVERTENT IFR IN VIETNAM 8
LTC Gordon R. Mullen
IT COULD HAPPEN TO YOU, MAJ Arlie Deaton 12
DUAL CONTROLS FOR NIGHT FLYING 15
CW2 Roy A. Johnsen
HELICOPTER SLINGLOADS IN FLIGHT 16
MAJ Robert S. Fairweather Jr.
AT LAST — USER ORIENTED CHECKLISTS AND OPERATOR'S MANUALS, MAJ William H. Gardner 22
DO YOU UNDERSTAND? WO1 Wayne K. Roberts 27
AIRCRAFT RECOVERY IN VIETNAM, LTC Emmett F. Knight 30
OBSERVATIONS OF A SCOUT, CPT Richard L. Greene 32
CRASH SENSE — FIGHT TO LIVE 36
MAJ Lawrence F. Beyer
PERSONAL MAINTENANCE, M. W. Windham 49
PEARL'S 51
BIRD DOG CLASSICS, Pierce Wiggin 52
STRESS RAISERS IN AIRCRAFT STRUCTURES 56
LTC Lester R. Kerfoot Jr.
COMMAND LETTER 62
USAASO SEZ 64
ALL IN ONE Inside Back

See page 16

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

The DIGEST is an official Department of the Army periodical published monthly under the supervision of the Commandant, U. S. Army Aviation School. Views expressed herein are not necessarily those of Department of the Army or the U. S. Army Aviation School. Photos are U. S. Army unless otherwise specified. Material may be reprinted provided credit is given to the DIGEST and to the author, unless otherwise indicated.

Articles, photos, and items of interest on Army aviation are invited. Direct communication is authorized to: Editor, U. S. Army Aviation Digest, Fort Rucker, Ala. 36360.

Use of funds for printing this publication has been approved by Headquarters, Department of the Army, 3 November 1967.

Active Army units receive distribution under the pinpoint distribution system as outlined in AR 310-1. Complete DA Form 12-4 and send directly to CO, AG Publications Center, 2800 Eastern Boulevard, Baltimore, Md. 21220. For any change in distribution requirements, initiate a revised DA Form 12-4.

National Guard and Army Reserve units submit requirements through their State adjutants general and U. S. Army Corps commanders respectively.

For those not eligible for official distribution or who desire personal copies of the DIGEST, paid subscriptions, $4.50 domestic and $5.50 overseas, are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

VIEWS FROM READERS

Sir:

As I read CPT Paul Maxwell's letter in the January issue of the DIGEST it brought back memories of my visit there [Vietnam]. I suppose that at one time or another, with the completion of the mission in mind, we have all been on the 20-minute warning light.

CPT Maxwell emphasized the point that the warning light could be inaccurate. I would like to add one point concerning the boost pumps on the UH-1B. If the left boost pump is inoperative there will be approximately 55 pounds of *unusable* fuel. If the right boost pump is inoperative there will be approximately 35 pounds of *unusable* fuel. This is due to the left fuel cell being mounted lower in the airframe.

The importance of this is outlined in the Operator's Manual, Chapter 2, Section II, pages 2-19, which states if a boost pump is inoperative on the UH-1B and the 20-minute warning light is on, there will be enough fuel for approximately 5 minutes flying at cruise power, instead of the normal 20 minutes.

I think this is very important here at the Aviation School, where we have a large number of UH-1Bs and student aviators. I would recommend that when a UH-1B was found to have a boost pump inoperative, that an entry be made in the dash 13 indicating that with the 20-minute warning light on, the aircraft is limited to 5 minutes of flying time. This entry should be carried forward until the pump is put into working order.

Jerry F. Irwin
Test Flight Section
Lowe AHP
Ft. Rucker, Ala. 36360

★★★

Sir:

The November 1968 DIGEST article entitled "Cleared to Land — Its Legal Portent" disturbed many of us at the Air Traffic Control School at Ft. Rucker, Ala.

While we do not question the validity of the example LTC Rusk used, we do feel it was an extremely isolated case. Also the article taken by itself could confuse Army air traffic controllers.

The author cites an example of a tower controller informing the pilot of an approaching aircraft that there was a storm 40 miles out. He claims the tower operator failed, however to advise the pilot of an isolated thunderstorm 20 miles out.

There are a number of errors in the article.

In the first place, the author speaks of the requirements contained in the "Army-Navy-Air Force-Federal Aviation Administration Procedures for the Control of Air Traffic (ANC/PCAT) Manual V."

This manual has been obsolete for several years. It has been superceded by TM 11-2557-29 and FAA Publication 7110.8, "Terminal Air Traffic Control Manual."

First, beyond what the manual says, common sense tells us (or should) a pilot in VFR conditions who flies into an isolated thunderstorm is indeed negligent, regardless of information that was or was not received from the tower.

However, to keep it within "Its Legal Portent," the manual continually stresses that the primary mission of controllers is the separation of air traffic. This includes the radar controller as well as the tower operator.

Chapter 2, "General Control," paragraph 25, of the TM states "Give first priority to separation of aircraft as required in this manual. Provide any other services or information to the extent possible."

The only way a tower operator would have specific information regarding a thunderstorm would be by seeing it himself, having received a PIREP or some radar facility relaying to the tower that there is a thunderstorm. The manual says you may relay such weather information but it is not mandatory.

It is not our intent to "pick" the article apart, however, on a stormy day it is not realistic to expect a tower operator to inform every aircraft of every isolated thunderstorm within a 40 mile radius.

It would be catastrophic if Army aviators believed that air traffic control tower operators were responsible for keeping them clear of isolated thundershowers.

MAJ Arthur R. Griffin
Chief, Tower Branch
Dept of ATC Training
Ft. Rucker, Ala. 36360

Sir:

I read with a great deal of interest "Aircraft Utilization" (Nov 68 DIGEST). Although maintenance was not specifically mentioned, aircraft availability was. Availability and maintenance are practically the same. Show me an Assault Helicopter Company where there is harmony between the commander, the maintenance officer, and the operations officer, and there will be better than average availability. If you have this combination along with harmony between the supported Brigade Commander and Staff, and the AHC Commander, records will be set, both with availability and aviation support.

I suggest that along with LTC Monts' plan that the following recommendation be made: AHC commanders, operations officers and BDE aviation officers spend from 30 to 60 days in either the service platoon of the AHC, or the Maintenance Detachment TO&E to the AHC.

Joe K. Bell
Major, Armor

★★★

A recent letter from Commander R. J. Copin, Chief of the Flight Safety Section, Headquarters, United States Coast Guard, brought to our attention an error in an article in the May 1968 issue of the AVIATION DIGEST entitled "Survivor Wishes to Meet Helicopter — Object: "Survival" by LCdr Robert C. Williams.

Commander Copin notes that the correct method to use when placing two injured men on the Forest Penetrator is to put the most severely injured man on *last* instead of first as was stated in the article.

The reasons for this, he says, are that the most seriously injured man must be in a position to be taken off first, and also that by placing the most seriously injured man on the bottom, it is possible that his injuries might be compounded.

Research indicates that the article as originally written corresponds with Commander Copin's views.

Our error! Good catch, commander!

Army Aviation's Future

Lieutenant General Harry W. O. Kinnard
Commanding General
U. S. Army Combat Developments Command

ARMY AVIATION is here to stay. Not only is its longevity assured, but new uses will grow from its development. Despite its overwhelming success in Vietnam, there are still those who, for various reasons, have serious reservations and questions about the future role it will play.

The emergence of another airmobile division together with the overall upgrading of helicopter support for all our own and allied forces in Vietnam indicates the importance our leaders place on Army aviation.

This rapid shift to an airmobile Army has not been made without criticism. When we were testing the 11th Air Assault Division and developing airmobile concepts and techniques many people expressed a feeling that such a force would have a limited value, restricted to low-intensity conflicts and counter-insurgency. They felt that if the enemy employed aircraft and covered his forces and installations with anti-aircraft weapons, Army aviation would be ineffective and the general concept of an air assault division would be of little or no use. In those days most critics clung to the belief that the helicopter was a fragile machine, short on fighting ability.

Obviously these critics had not taken the time to study the results of the air assault tests. During two-and-one-half years, more than 100 closely supervised field tests, wargames and analyses pitted air assault forces against nearly every conceivable combination of enemy, weather and terrain. In fact, more effort was expended on developing the concept for application in conventional and nuclear war situations than for low intensity conflict. The final division-level exercise, Air Assault II, matched the 11th Air Assault Division against the 82nd Airborne Division reinforced with armor and anti-aircraft weapons under conditions of mid and high intensity conflict.

Furthermore, when the fighting in Vietnam is over, or has subsided to a considerable extent, other test groups will surely pick up where the 11th Air Assault Division left off. These will be specifically tailored for various combat intensities in which all key questions will be answered by a battery of tests. Obviously the knowledge gained in Vietnam will be used wherever it is applicable to other conflict environments.

Already Vietnam has shown that in addition to the physical advantages of an airmobile capability there is also a tremendous psychological impact. With the possibility of attack from any direction at any time, the enemy cannot relax its guard for even a brief moment. He must also provide as heavy protection for rear and flank as for his front. The threat of airmobile assault has nullified to a great degree the very concept of a "front."

When critics ask what will happen to Army aviation if the enemy has air superiority, they should consider what would happen to our entire Army. Everyone has to adjust; the threat is not unique to airmobile forces. During exercises in the Carolinas, effective and workable plans for dispersal of flying aircraft and for the hiding and dispersal on the ground were developed as defensive measures against hostile aircraft. From the beginning we trained to work with the Air Force, whose responsibility it is to maintain air superiority over any enemy. Forward air controllers trained with us at Ft. Benning and in the Carolinas and later proved invaluable in Vietnam. This close teamwork in these areas as well as in reconnaissance and transport support will continue.

The Army's Combat Developments Command (CDC) conducted extensive instrumented field experiments on the survivability of the helicopter at the Experimentation Command at Hunter-Liggett, Calif., and their findings have proven to be amazingly close to our actual combat loss experience in Vietnam. Far from being a fragile machine, the chopper has proven to be capable of withstanding tremendous punishment. Further, we have determined that it can, in fact, fight and be maintained in the forward environment of the battlefield.

I like to define airmobility as the use of aircraft whenever and wherever the use will give our forces an operational advantage. What constitutes "advantage" in Vietnam may not necessarily be so at another time or in a different type of war. In such a case, a new application must and can be made. As aircraft become more compatible with needs of the ground forces — and this is seen in Vietnam — the soldier will develop a greater reliance on aviation and turn more and more to it for support.

Indisputably, this is already happening. Traditionally pitted against terrain and weather, as well as enemy, the ground soldier is finding himself largely freed from the "tyranny of terrain" because of the helicopter. He is now delivered into battle at the place of his choosing free of fatigue and supported by a vast array of firepower. Furthermore, advanced avionics devices, many already fielded and others on the near horizon, are enhancing our ability to cope with poor weather and darkness. Thus relieved from many of the until now taken for granted obstacles of terrain and weather, the soldier can concentrate full effort on his primary fighting mission.

Certainly worth remembering as well is that the helicopter's applicability and popularity does not end at the battlefield or with troop supply. Perhaps one of its greatest long-range advantages is that it is one of the few combat arm resources that plays an important role in civic affairs. It is somewhat difficult to imagine how a 105 mm howitzer or a .30 caliber machinegun could be of assistance in a civic action, but the helicopter can deliver needed supplies, evacuate sick and wounded villagers and help rebuild structures destroyed in combat. This "noncombative" role of the helicopter presages its increasing use in peacetime civil affairs, such as traffic control, engineering, medical evacuation, law enforcement and a host of other roles.

. . . its applications are so ranging that it cannot be excluded from any developmental cycle

While the basic concepts of airmobility have proven even more sound than many anticipated, necessary and natural evolution must continue to occur. Army aviation, like any weapons system, cannot be stagnant and like other systems is constantly evolving. Throughout this evolution, constant evaluation is a must. This is precisely the reason for the Combat Developments Command, organized as a major command in 1962 to determine how the current and future Army should fight, be organized and be equipped. Studying and projecting the Army's needs literally from today through the 1990s, it sees a goal of a "Total Land Combat System" where each component subsystem is optimally integrated with the requirements and capabilities of the others.

As for airmobility as a "system," certain trends are already self-evident. Troop carrying helicopters designed to carry a squad must be able to carry that full squad under all probable density altitude conditions, a capability that does not exist today.

Also, in avionics there is a series of steps that are being taken to strengthen the airmobile system. Until now the approach has been a rather haphazard "shoe-horning" of single purpose electronic "black

Army Aviation's Future

boxes" into the airframe to meet a specific need, this with little or no consideration of likely avionics advances during the design and production of the airframe. Emergency or expediency were the guiding motives.

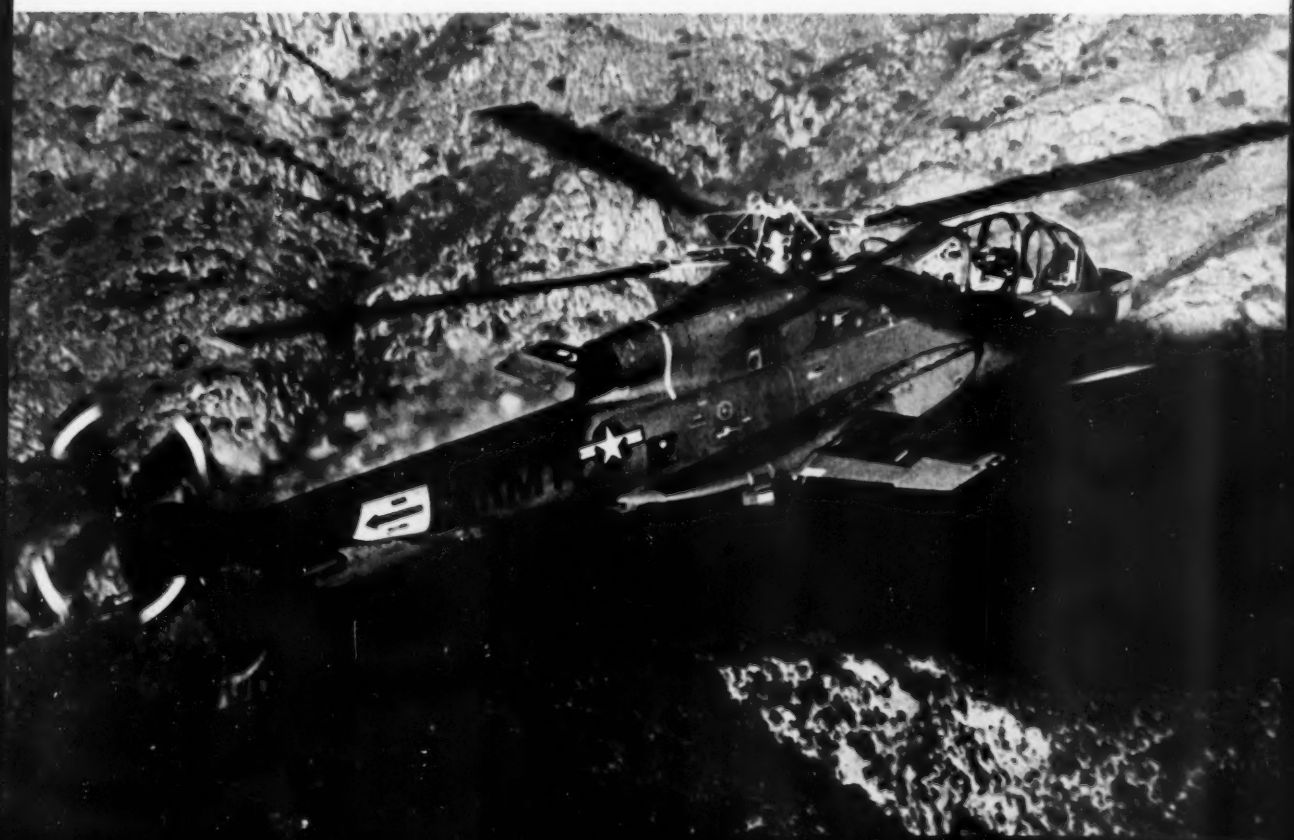
Now, however, CDC's masterplan for avionics uses a standardized systems approach included, for example, in the development of the AH-56A Cheyenne for an advanced aerial fire support system. With this approach the aircraft and avionics equipment are designed in harmony so that we avoid the expensive and inconvenient retrofit problems like those following fielding some of the Army's earlier light observation helicopters ahead of the completion of a suitable integrated avionics package tailored for them.

Because Army aviation has become more than just a source of increased mobility to our forces, because it is actually replacing older ground-bound systems, it must occupy a place of honor in the developmental program. Its possible applications are so wide-ranging that no other system in the development cycle can exclude its consideration. As we pursue every possible means to improve Army's fixed wing surveillance and target acquisition capability, we are also deeply involved in streamlining and advancing VTOL systems in every form.

The future begins today — as today's future began yesterday — and Army planning, to respond effectively to its needs, must be oriented toward immediate, mid-range and long-range time frames. The farther into the future we look the less restricted we are by Army's current doctrinal, organizational and materiel facts of life. By the same token, however, some of these constraints are healthy; they furnish starting points for immediate improvements and for long-term analysis of developmental goals. Nevertheless, the great advantage of long-range planning lies in the amount of "developmental lead-time" available. This lets us pattern shorter-range improvements and systems to facilitate, even spawn, long-range military capabilities.

Army's current helicopter fleet is an excellent take-off point for defining future requirements. Bell's UH-1D Iroquois (Huey), Boeing/Vertol's CH-47 Chinook, Sikorsky's CH-54A Flying Crane and Hughes'

The AH-56A (below) is a result of a standardized systems approach



OH-6A Cayuse observation helicopter form the nucleus of our current inventory. Earlier models like Sikorsky's UH-19 Chickasaw, CH-34 Choctaw and CH-37B Mojave, Hiller's OH-23 Raven, Vertol's CH-21 Shawnee and Bell's OH-13 Sioux continue to serve until more up-to-date aircraft are available to replace them. From these operational aircraft and a large array of experimental helicopters the Army has accumulated a wealth of data and know-how.

From this solid base we are now looking to the future. In general terms these future aircraft will aim at reduced specific fuel consumption, improved three dimensional stability during hover and at all speeds, empty-weight to useful-cargo ratios approaching 1:1, improved reliability, maintainability and availability, improved safety and survivability, as well as all-weather, day-and-night flight control systems and avionics packages. Furthermore, rapid worldwide deployment capability will be boosted by extended ferry ranges, by inflight refueling systems and by internal loading into cargo aircraft. Cargo landings and unloading procedures and facilities will be polished to adapt optimally to the endurance and speed characteristics of individual craft. Furthermore, a constant goal must be reduced costs so we don't price ourselves out of business.

The AH-1G Cobra which recently joined the Army represents a fine example of product improvement to improve our fleet. An outgrowth of the UH-1B, the Cobra has similar transmission, engine and rotor systems, but the Cobra has been streamlined and has greater range, speed, maneuverability and weapons payload. It has been integrated into the Army inventory without much modification in the training of pilots and mechanics or the operation of supply and maintenance tasks.

The AH-1G Cobra represents a fine example of product improvement which increases the effectiveness of the Army's helicopters

During its first year in Vietnam the Cobra has been highly effective including applying discrete fire in built-up areas as demonstrated during the Tet offensive. One combat veteran remarked that "you have the confidence to ask for fire from these choppers at targets just across the street. You just wouldn't ask for artillery or any other kind of fire except small arms under those circumstances."

Beyond product improvements the more distant future provides an opportunity for the systems approach developmental method and for unprecedented standardization of equipment.

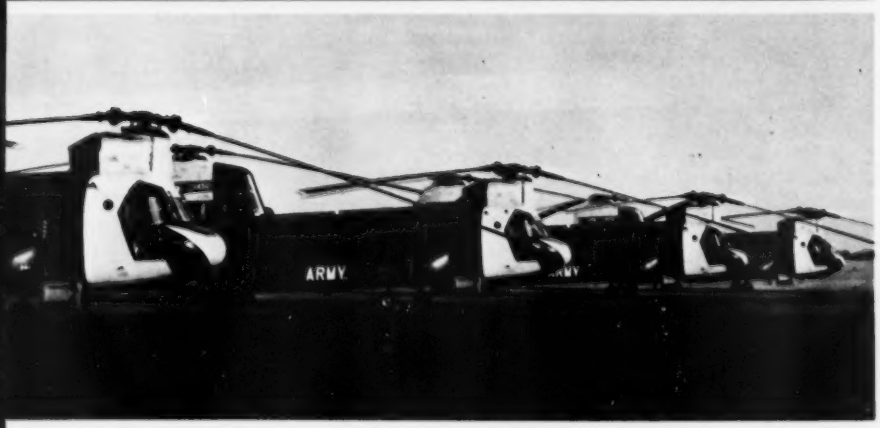
Due for fielding in the early 1970s is the Advanced Aerial Fire Support System (AAFSS), mentioned earlier. The Cheyenne compound helicopter by Lockheed is a prime example of the systems ap-

Army Aviation's Future

proach. The performance of its separate but cross-related components, such as its avionics package, stainless steel rigid rotor system and 27-foot wing span, may prove very influential in determining related requirements for other members of the future fleet. Cheyenne's weapons employment capability, day-and-night target acquisition facilities and weather versatility make it the most potent of aerial weapons systems so far devised by the Army. It will, needless to say, be watched intensely.

The Utility Tactical Transport Aircraft System (UTTAS) is scheduled for production in the mid-70s to replace the UH-1 in its many roles of all-weather day and night operations, troop lift, medical evacuation, command control and communications and special missions. A Phase I study to establish the aircraft's mission and performance requirements for tactical movement of troops and their supplies in the 1975-85 time frame was recently completed at the CDC Aviation Agency, Ft. Rucker, Ala. Highly technical studies involving trade-off evaluations and cost effectiveness are the next steps in the UTTAS developmental cycle.

Army planners are working on the Utility Tactical Transport Aircraft System (UTTAS) which is scheduled to replace the famed Huey (above) in the mid-70s. Meanwhile the Light Tactical Transport Aircraft System (LTTAS) is in the initial stage of concept formulation phase and may replace the CH-47 (below) in the late 1970s



The Light Tactical Transport Aircraft System (LTTAS) is in the initial stage of concept formulation phase with production targeted for the late 1970s. Perhaps as a replacement for the CH-47, LTTAS is being designed to handle outsized loads and perform recovery and other transport missions. It is envisioned with both internal and external cargo capability in addition to its ability to serve as a troop carrying vehicle.

All of the armed services and the new Department of Transportation have displayed interest in joining to explore the developmental plans for heavy lift helicopters (HLHs). It is reasonable to assume that the eventual product will include many physical characteristics of current VTOL craft with as much improvement as the state-of-the-art will allow.

By the mid 70s an initial version of a 20 to 30 ton heavy lift helicopter could be ready for fielding, and by 1980-85 it should be possible, if still desired, to produce a very heavy lift aircraft system of large transport helicopters with payloads of 40 to 50 tons for intratheater logistical and operational needs. Recent advances in V/STOL technology have made more feasible the development of intratheater logistical craft for delivery of cargo within the combat zone. Also a form of compound helicopter could transport cargoes with VTOL performance features and faster cruise speeds.

As in the case with all future VTOL development, the production of a specific Surveillance and Target Acquisition Aircraft Sys-

tem (STAAS) in the mid-70s will provide innumerable fall-out products for incorporation in still-later models and types of VTOL craft. The guts of STAAS are the sensors. We are currently working with the Army Materiel Command on a Sensor program which, when completed, should vastly improve our surveillance and target acquisition capability over the current system which is, however effective, largely improvised.

All in all, VTOL aircraft designs presently in the developmental or consideration phases attempt to direct some of the thrust of various aircraft propulsion systems into vertical lift. By 1980 we can expect to produce in mass a small helicopter whose training requirements, safety, economy and utility will approximate that of present small fixed-wing aircraft. Current research will provide a basis for designing rotor systems with greater mechanical simplicity and much-improved payload-to-gross-weight ratios. Blades capable of higher speeds and the continued sophistication of compound helicopter characteristics will all have advantageous effects on chopper propulsion, speed and mobility.

Tilt-wing and tilt-propellor VTOL aircraft have been successfully tested, employing tilt to either or both the wings and props. Craft of this sort, with cruising speeds from 300 to 400 knots for mission radii of 300 to 500 nautical miles, could be operational in the 70s.

By 1985 we could have a stopped-rotor aircraft combining the takeoff and hover features of choppers with the high speed, low-drag features of fixed-wing aircraft. Collapsible and foldable VTOL craft capable of assembly by trained personnel in 30 minutes are not beyond the realm of possibility.

By 1973-77 we may well be using triangular rotor aircraft systems with an equilateral triangular platform that can be stopped for high-speed flight. Flexibility of the rotor for adaptation to delta wing or inverted delta wing configurations would enable such craft to be aerodynamically suitable for transonic, subsonic and supersonic flight patterns. With rotors fully stopped, the craft would also have fair glide characteristics and be able to make conventional power-off landings without autorotative lift assistance, though it would still be capable of autorotation.

The challenge of Army aviation lies now in exploiting its full potential, matching hardware with concepts for its employment and trained men in sound organizations before it flows from the production line and heads to battle like a "surprise package." General William C. Westmoreland, Army Chief of Staff, said recently that we "have just reached the threshold of this process in relation to the helicopter and the airmobile concept . . . but I offer this caution, I do not think that we have any more than reached the line of departure. Having achieved the ability to use the helicopter and employ the tactic of airmobility, we should now 'take off.' This is not the end; it is the beginning."

A Cheyenne First

The Army's AH-56A Cheyenne, world's most advanced combat helicopter, fired its first TOW anti-tank missile in flight test at Yuma Proving Ground, Ariz. TOW is a tube-launched, optically-tracked, wire-guided missile. Traveling about 100 knots, the Cheyenne scored a direct hit in this fullscale engineering test.

Inadvertent IFR In Vietnam

When an aviator has had the training, it becomes a common problem to insure that he maintains enough proficiency to recover from inadvertent instrument conditions

Lieutenant Colonel Gordon R. Mullen

THE PAST FEW weeks had been busy ones on the Bong Son coastal plain. An NVA battalion-sized force had been crushed when it was discovered fortifying a village. The maneuver elements of the 1st Airborne Brigade, 1st Cavalry Division (Airmobile), had quickly surrounded the enemy and ended its existence as a fighting force. As the brigade aviation officer and organic aviation commander, I considered it fortunate that we had lost only one OH-13S scout helicopter to enemy ground fire without injury to the crew.

Now I was preparing the brigade commander's UH-1D command and control helicopter for the 35 minute flight to the division base camp at An Khe. The colonel had managed to log 100 flying hours on his new bird in less than a month so it was time for the helicopter's first periodic inspection which was to be performed at An Khe. The flight would be made toward the close of the day. The inspection would be performed during the night and the ship flown back to the field location at first light. I planned to make the administrative type flight with just the crewchief since the regular crew was manning a substitute helicopter which would be standing by during the night.

These infrequent trips to An Khe allowed me to check on unit personnel there and also on those administrative matters which couldn't be accomplished in the field. A few months previous to that day in April no one could have convinced me that An Khe would be a welcome sight. Now I began to anticipate the hot shower, good billets and other niceties of the permanent camp at An Khe.

Everything had been planned for I thought as I went through the pre-start checklist, even to an early takeoff so that An Khe pass could be traversed before nightfall. The hills on both sides of the pass were littered with broken aircraft which had not made it though the "V" shaped entrance to the Central Highlands. Good aviators with whom I had served only a short time before had met their fate trying to cross the pass in bad weather. My thoughts were interrupted by the gloomy news from the crewchief that the fuel filter was leaking around the rubber seal. Dejectedly, I paced around the UH-1D while a new O-ring was installed. The job took 20 minutes.

As I finally took off I noted that it would be dark in less than one hour but the flight time to the pass was only 30 minutes. Daylight should still prevail upon my arrival there. No significant weather had been reported or forecast for the entire flight route.

Approaching the An Khe pass from the east with the crewchief beside me in the copilot's seat, I could see the shadows lengthening on the ground. What concerned me more than the shadows was a puffy layer of clouds directly over the pass which effectively hid the red ball of the sun. The elevation of the pass was approximately 1,900 feet above sea level. A call to the An Khe tower revealed that a pilot's report 20 minutes earlier gave the altitude of the clouds in the pass as 500 feet above the surface. The weather at An Khe consisted of a scattered cloud condition with good visibility. Ahead the sky grew blacker and blacker as I neared the pass which was usually sharply silhouetted against the setting sun at that time of day. Now it could not be distinguished from the higher terrain to the north and south.

The terrain now started to slope upward from the sea level coastal plain. While I adjusted my altitude to 2,200 feet indicated I watched the headlights of the many trucks inching their way up the steep zig-zag road to the pass. Now we were inside the bowl-shaped terrain just east of the pass and getting very close to that still invisible pass. A minute earlier I was confident that my altitude would give me 300 feet terrain clearance through the pass and 200 feet separation from the clouds. But then I was sure I would be able to see the pass. Exactly how high were those ridges north and south of the pass? Suddenly I noticed there were no more truck headlights below. I had counted on truck lights to show me the exact location of the pass even if the pass itself was not visible.

For the next few seconds I considered turning back to the east. All at once the world outside the helicopter turned opaque. Only the reflections of the rotating beacon and navigation lights were visible outside. As my eyes sought out the flight instruments, I ordered the crewchief to turn off the outside lights. He did so, quickly, but still nothing could be seen outside the aircraft. For a split second I considered turning 180 degrees left to fly back out of the mountains but the remembered vision of those wrecked aircraft on the slopes below quickly caused me to discard that dangerous maneuver.

The most recent tragedy in the pass occurred when a UH-1D had attempted to traverse the pass from west to east in extremely marginal VFR conditions. In trying to follow the zig-zag of the highway at low altitude, the helicopter had slammed into a hill. At least I did not have to worry about making a choice between VFR and IFR flight. The milky darkness outside took away any possibility of flight with reference to a natural horizon. My biggest worry was the ridgeline rising to the north and south of the pass. We had to clear that terrain or else! I increased power, started to climb and reduced airspeed to 60 knots in order

Inadvertent IFR In Vietnam

to gain time for the helicopter to climb. Now I was settling down on the instruments and heading for where I calculated the pass to be. The UH-1D bore on through the darkness for what seemed an eternity, although it couldn't have been more than two minutes. The altimeter read 2,800 feet and climbing. Had I thought about it, I probably would have been grateful for the Army Aviation School training which taught me to turn on instrument lights early if night flying was a possibility during the flight. Having well-lit instruments helped enormously in the sudden change from VFR to IFR flight conditions which occurred just as daylight was ending.

Of course all these were afterthoughts because at that moment I was concentrating on flying the helicopter. Then came a beautiful sight as the perimeter lights of An Khe could be seen straight to our front. We were safely through the pass! When we first went into actual instrument flight conditions, we were on the south side of the road and when we broke clear of the clouds, we were on the north side. I asked the crewchief to put on the navigation lights and rotating beacon while I called the "Golf Course" control tower for landing instructions. Due to the training I had received in the helicopter instrument flight course, what could have been a catastrophe was merely another incident of the flight. Not too many days later the pass claimed its next victim when a helicopter crashed in the pass while flying from east to west at approximately the same time of day. While no one knows for sure what actually happened, it is possible the disappearance of the visible horizon together with a lack of instruments for IFR flight caused the pilot to become disoriented and crash.

As we flew on toward the lights of An Khe, I asked myself whether each of our 18 aviators would be capable of surviving inadvertent IFR flight. All of them were carrying a standard or tactical instrument qualification but there was little opportunity to maintain proficiency. Although we were not required to maintain yearly minimums in the combat zone we had a unit policy that every aviator would try to fly at least 20 hours under the hood, or preferably, actual instruments during his year in Vietnam. A progress board was maintained in operations and the unit instrument instructor was available to fly with any aviator who could be scheduled. Now I began to think that more would need to be done to keep our pilots proficient on instruments. The price of low proficiency was too great. I though of the rainy nights I had flown the "Old Man" to division headquarters with radar control and the gauges making the flights possible. Instrument proficiency was a necessity for every rated aviator in the Central Highlands.

The landing at An Khe was uneventful but the ground felt especially good that night. One of my first tasks after landing was to greet three recently rated aviators fresh from the U. S. When meeting new arrivals such as these, it is natural to feel a little wise and experienced as they ply you with questions. After the experience at the pass, I could only feel very humble and grateful to still be around. Of course, one of the first questions I asked them was to inquire about the state of their instrument flying proficiency. They were all tactically instrument rated and very eager to try out their skills on actual missions. I outlined our unit instrument training program and assured them they would get their share of bad weather flying. Of one thing I am certain, these new aviators could feel my sincerity as I stressed the importance of being able to fly a helicopter on instruments. They could not hear the silent prayer I offered that their instrument training would be adequate for the days ahead.

Now the 1st Cavalry has moved to new battles and new battlefields. Conversations with returning aviators do not indicate any lessening of the need to be sharp on instrument flying. Dusty conditions stirred up by rotorwash continue to take their toll in men and aircraft due to inadvertent instrument flying conditions close to the ground.

Back in the U. S. the ancient argument is still floating around that a little knowledge is dangerous and a tactical instrument rating is a license to kill oneself and others. To earn a tactical instrument rating, the fledgling helicopter pilot must be able to make an ADF and GCA approach and he must know enough about flight planning to prepare, file and fly an instrument flight.

It would be grim indeed to contemplate the thoughts and feelings of an aviator who goes into instrument flight conditions without having had the training necessary to fly a helicopter on instruments. When the individual aviator has had the training, it becomes a command problem to insure that the aviator maintains enough proficiency to recover from inadvertent instrument flying conditions.

This story was written with the hope that it will prod some aviators into maintaining their instrument proficiency — those who might otherwise let it slide until annual renewal time. A very true saying goes as follows: "Learn from the experience of others, you won't live long enough to make all the mistakes yourself."

PERIL

THE MAGAZINE FOR HE-MEN

VOL 1 NO 1
MARCH 6

All we had to do was swim the raging river to reach the helicopter which had landed 300 yards away

It Could Happen to You!

See page 12

It Could Happen To You

Major Arlie Deaton

THE "male magazine" treatment is meant to put you on these pages in the right frame of mind for the article which follows. The article will serve its purpose if as a result a single aviator, just one, will be impressed enough to make plans prior to each and every flight for survival in the event of a crash.

As I hung up the phone in the sandbag bunker which served as the guard house for the MACV compound, and walked back to my "hooch," I felt the same slow burn I had felt many times before when required to do something I disagreed with. The irritation this time was the fact that I had just received a call from the company operations officer, with a mission for me to "conduct a mountain checkout for a newly arrived aviator today." My argument: "It's 1415 hours on Sunday afternoon, all the VR missions have left for the day, the checkout will be more realistic tomorrow on an actual mission." No good, I was involved in a grudge tennis match, behind one set, ahead one game (5-4), a real close match.

I was a platoon leader in a fixed wing airplane company in the Republic of Vietnam. Our mission was to maintain a visual reconnaissance program. I had been in country two and one-half months, a captain with nine years' service, a prior enlisted man, definitely motivated toward a military career, not so motivated toward a tour in Vietnam. I was also an instructor pilot in the O-1 Bird Dog charged with the additional responsibility of conducting the mountain portion of the company checkout for newly assigned aviators.

As I walked by the MACV tennis court enroute to my hooch, my opponent, CPT Briggs, called, "Hey Deat! Your serve!"

"I've got a mission, Don."

"Well, that's the best excuse I've heard lately," gloated Briggs.

When I arrived at the airfield, the aviator I was to check out was

hanging on the strut of the O-1 he had flown up on the 15 minute flight from headquarters. He was grinning like a possum. As I approached the plane, he waved, still grinning, no flack vest, no side arm, no jungle fatigues, just grinning and waving at me! A lieutenant and a new aviator at that, waving at a captain, a combat veteran! Well! I'll put him in his place!

'Hello lieutenant! Didn't they teach you to salute in basic? That's better. Now, let's get down to business. Get out your map of this area. I am going to acquaint you with the do's and don'ts of mountain flying, give you a taste of updrafts and downdrafts and probably give you a chance to get shot at. Any questions?"

"No sir!"

"O.K., here's the area we'll be looking at, a real hot area. We know that the NVA are active here and hope that with enough emphasis we can get a ground operation in there soon. Any questions?"

"No sir!"

"Ready to go?"

"Yes sir!"

As we roll down the runway on takeoff, I began to feel better about the whole thing. I think to myself, "He appears to be a nice kid, probably pretty conscientious, a right good aviator, a fine officer, takes constructive criticism real well, I should be able to help him quite a bit.

"O.K. lieutenant, turn left to 045 degrees and climb to 3,500 feet, these mountains average 2,500 and we want to conduct this mission at around a thousand feet above the ground."

As we fly northeast along a ridge line, I recognize an area where I know there are several huts that are partially hidden under the trees. I decide this is the time to show "my student" how to make a low pass down a valley.

"O.K. lieutenant, I've got the aircraft. I think I saw something at about 2 o'clock, down by that small stream. I'll demonstrate a low pass and take a look. To make a low pass some of the things to keep in mind are: get the sun to your back, make a change of direction prior to starting your descent, airspeed should be around 130 mph and make your climbout away from any rising terrain."

I applied carburetor heat, reduced power and executed a modified wing over, taking care to follow the advice I had just given. I was unable to point out the huts (which I expected), however on

He didn't see us

climb out from the low pass we were both very surprised. The engine lost rpm!

The things I thought of and did over the next few seconds would fill a good sized book, but for brevity's sake, I'll skip the details of the forced landing that followed.

We were both shaken but uninjured as a result of the crash, "You O.K. lieutenant?"

"Yes sir."

"O.K. get out of the plane and slide the seat forward so I can get out."

I informed the lieutenant that I had been unable to get an answer to my Mayday transmission and that we might get visited by Charlie before help arrived. We talked it over and decided to get away from the crash site as quickly as possible. Breaking into the survival kit, we took what we felt that we needed, and started south along the small stream (which was really a 50-yard wide river of undetermined depth, as we later learned) toward a regional forces outpost about 10 miles away. We had crashed in a clump of young bamboo about 12 feet high which really made the going rough.

After about 30 minutes we had hacked our way through the bamboo thicket (about a hundred yards) and onto a well used trail under the jungle canopy. We talked it over and decided that the trail, even though dangerous, would get us out of the immediate area in a hurry. (As I look back on the incident, I consider this decision very foolhardy, even more so than the decision to leave the aircraft.)

We moved along fairly rapidly considering the load we each were carrying and the heat. After about two hours we were completely exhausted. We had passed several camp sites and smaller trails joining the larger one. By this time we had thought about the situation and were really scared.

Suddenly we heard the barking of a dog back to the north. Having been reared in the hills of eastern Kentucky, I knew the sound of a tracking dog, and this dog was definitely on trail!

"Well, lieutenant, it sounds like they've found the aircraft and are using dogs to follow us (still playing the combat veteran). Maybe we had better try to cross the stream and lose them."

As we approached the stream which was off the trail about 50 yards, we could see the mon-

soon rains had caused it to swell out of its banks and become a raging torrent. Still, despite of the swiftness of the water, we felt it might be shallow enough for us to walk across. Not so! I stepped in water up to my neck just 3 feet from shore, and was washed down stream. The lieutenant grabbed my extended M-16 rifle and hauled me ashore, wet, discouraged and even more scared than before (a poor excuse for a combat veteran).

We were flexible: O.K., so we can't cross the river — they won't take us without a fight! We discussed our defense and decided to keep the river to our backs and defend on a 180 degree front. Sounded good. A small depression near the river afforded us good concealment and some cover. We waited.

The time was 1845 hours. It would be dark soon. I had lost some of our provisions in the river, but neither of us was hungry. However, we had inventoried our meager supplies for any future plans. We had a can of beans and franks, five bouillon cubes, two chocoiate bars, a pack of cigarettes, a fish line and two hooks, a machete, a poncho, a roll of C-ration toilet paper and 10 magazines or so of ammo. It was not much in the way of luxuries.

While pondering our most undesirable situation, we heard a Bird Dog, the kind that flies. I looked up through the jungle canopy and glimpsed the O-1 flying north at low altitude. One of my platoon aircraft looking for us. If he only sees us!

"Lieutenant! Get on the emergency radio and try to contact that aircraft." I shouted, waving the yellow side of the poncho we had taken from the survival kit.

As the aircraft flew out of sight and the drone of the aircraft engine faded, I stared dejectedly at the lieutenant, transmitting desperately into the wet and obviously inoperative radio.

"It doesn't work, sir, it doesn't work," he said.

"Listen! He's coming back! We've got to make him see us this time! Help me get this poncho up on the top of these bushes!"

We struggled, tumbled, and almost fell into the river before getting the poncho into a position visible from the air. As the aircraft came into view, I hurriedly grabbed my pen gun and fired a pencil flare. It didn't go off! I tried again! No soap. I quickly unscrewed the

It's still your serve!

dud from the pen gun and readied a new one. I fired directly at the aircraft. He turned just a few degrees and then continued southward. He didn't see us! Dejected, we pulled down the poncho, resigned to the fact that our next step would be to escape and evade to the Montagnard outpost.

It was almost dark when we heard a most pleasing sound — a UH-1. That beautiful aircraft flew right over our position! Right behind the O-1. He had spotted us after all!

The Huey flew over very low and slow. The pilot pointed across the river, then landed about 50 yards beyond it just across from us. As the O-1 circled overhead, we knew that all we had to do was swim the raging river to reach the safety of the waiting helicopter. Without hesitation, we gathered all our equipment, threw it into the stream as far as posssible and plunged into the murky water.

'See you on the other side, lieutenant," I gurgled as I went in over my head. I swam with all my might, my jungle fatigues and boots like lead on my body. I went under several times and had almost given up when I finally dragged my aching body ashore. I lay there for two full minutes before I could raise my head in search of my friend. I saw him about 20 yards down stream, on the river bank. I had swallowed about two gallons of river water and believe me it wasn't potable.

When we crawled aboard the helicopter, the pilot, a friend of mine, smilingly reached out to shake my hand.

Back at the compound who should I pass but Don Briggs.

"Hey Deat! It's still your serve."

"Don, hang that tennis racket on your ear," I had to smile.

Now I'll grant you that this little piece of pen work is pretty melodramatic. Did it really happen? You bet your Bird Dog it did. This and many other instances very similar to it. Some of them didn't end as luckily as this one. A captain, combat veteran and a new aviator lieutenant were prepared for a normal flight, terminating at home field. Nothing else. Many thousands of flights are conducted each day with the crew just as unprepared as these two pilots were. So take a tip from experience, prepare yourself for each mission with the thought that you might have to walk home.

Dual Controls For Night Flying

As an IP, has your ability to recover from a serious situation ever been impaired by a cockpit design deficiency?

CW2 Roy A. Johnsen

. . . *Responsible for the aircraft and to prevent the student from exposing you to a situation that will exceed your capability to recover.*

IT HAS BEEN SEVERAL months since I completed MOI and received these words of advice. I started my duties as a UH-1 instructor pilot cautiously — awaiting the unexpected. I didn't have long to wait. On a routine cross country at night I had a forced landing. I then realized that the UH-1 IP does not have complete control of his aircraft during night flight training.

You are now asking yourself, What does he mean by complete control of the aircraft? Now let me ask you this: How many times have you had to reach across the pedestal and readjust the landing or searchlight or for that matter just turn them on? This is a very common problem during night training. We cannot place the blame on the student because of the limited amount of time allowed for training. Therefore, I feel we must have dual searchlight and landing light controls available to the IP in all UH-1 training aircraft, to insure the IP can maintain a higher degree of control of his aircraft under all situations encountered during night flights.

Let's now consider the students' normal night training phase. The student pilots are introduced to night flying in their second week of a four week transition phase. Most of the students are still not completely oriented to the cockpit and its total function. We begin our night flying with a thorough demonstration of the lights until we feel they are capable of handling the system without any trouble. We now use the lights for straight-in autorotation and simulated forced landing only. This is generally where a student gets his practice with the lights. The majority of IPs I've talked to agreed with the idea of a dual lighting system.

Let's look at an example. The student and IP entered autorotation with their lights on and set in the desired position. Halfway through the autorotation the IP instructed the student to bring the searchlight down. To his surprise the light disappeared into the dark sky. The IP then had to reach across the pedestal to quickly reposition the searchlight and completed the touchdown with no further problem. There have been many such instances where the students move the light everywhere but the right spot. Several students have actually turned the lights off thinking they were repositioning them. These errors are very common and have a tendency to create gray hairs. Again, this shows the need for a change and quickly.

In recent months night forced landings have been on the increase. Of course the majority of IPs agree that a night forced landing is a critical maneuver and requires every bit of skill and luck one has. As IPs, we must quickly evaluate the situation and respond with the proper corrective action. At the same time it becomes the student pilot's responsibility during this strange situation to adjust the lights under pressure. In the event the student is unable to respond correctly, it is then up to the IP to remove one of his hands from the controls in order to adjust the light properly. This could result in a dangerous situation for the IP since he only has a few seconds during a forced landing.

Here is an example of a night forced landing. During cruise flight the engine quit and the IP entered autorotation and instructed the student to turn on the lights. The student was fully aware of the location of the switches; however, it took over five seconds to get the lights on. The IP then decided to adjust the searchlight himself, since time was at a premium due to his altitude. If the IP had had dual light controls on his side he would have had more time for concentration on the instruments and getting off a radio call for assistance.

I have experienced a similar situation. We were on a routine night cross country flight when my precautionary landing quickly turned into a forced landing. I instructed the student to turn the lights on; this was accomplished with no problems. The problem began as I instructed the student to get the light further down. The student extended the light to the full forward position, up into the sky. I then spoke with more authority and loudness to get it down! It then was too late and the landing was accomplished. There is no doubt in my mind that a dual control unit is needed because we cannot depend on a student to react correctly during a night forced landing. This present condition severely restricts and limits the IP while making a successful night autorotation. Therefore exposing him to a situation that will exceed his "capability to recover."

Helicopters Slingloads In Flight

The aviator must have knowledge of the flight characteristics of these loads

Major Robert S. Fairweather Jr.

AIRMOBILE OPERATIONS generally depend upon aerial resupply. One of the most efficient methods of accomplishing this resupply is external transport of loads by helicopter — a technique responsible for the movement of thousands of tons of cargo weekly in Vietnam. Many techniques have been developed to facilitate aerial operations of this nature. If these operations are to be conducted safely and effectively the supported personnel must have the ability to properly rig and prepare loads. And just as important, the aviator must have knowledge of the flight characteristics of these loads. A discussion of the latter area follows:

To intelligently discuss helicopter slingload flight characteristics, one should be familiar with the equipment involved. Three helicopters currently employed by the U.S. Army serve well to cover the spectrum of helicopter types found throughout the world. They are the UH-1D Huey, the CH-54 Crane and the CH-47 Chinook (see photos at right). Army aviators, for the most part, are aware of the general characteristics of these helicopters and it should suffice to review only their peculiar slingload support systems.

The UH-1D has a single point external cargo suspension system cap-

A 9th Infantry Division soldier of the 147th Assault Support Helicopter Company leaps from a 2½-ton truck as ammunition is sling-loaded on a CH-47 Chinook helicopter.

able of sustaining loads up to 4,000 pounds. The cargo hook is located near the center of gravity, is free to swing fore and aft and laterally about a single fixed point, in some cases is free to swivel and has spring centering devices to limit cargo swing. In contrast, the CH-54 has two types of load suspension systems capable of handling loads up to 20,000 pounds. The first load system allows four-point suspension through the use of four load levelers which lift the load clear of the ground, dampen oscillations and level the load (see front cover). The second load system incorporates a single point suspension through the use of a hydraulic hoist (with dampener) located near the center of gravity and incorporating a freely swinging and swiveling hook attached at the runing end of the hoist's cable.

A truly unique system is found on the CH-47. This single point suspension system is capable of handling loads up to 16,000 pounds (20,000 pounds on CH-47B). Suspended at the center of gravity, the cargo hook is attached to a roller assembly which is free to roll on a laterally mounted curved beam. The beam is attached to the primary structure with gimbals on each end to allow free fore and aft rotation. The curve is designed to keep the load centered on the beam when the aircraft is level. In effect the hook not only can swing in all directions but it can displace laterally several feet. It is not free swiveling, however.

To attach the cargo to the hook, the following equipment has become fairly standard in the inventory: the use of a nylon "donut" to hook on to the cargo hook; the use of a large metal clevis to attach to the "donut"; the use of three loop, 10,000 pound capacity nylon slings ranging from 8 to 20 feet in length to attach to the large clevis; and small clevises or other devices to attach the slings to the load.

Although many items have been hauled by helicopters, typical loads for Army helicopters include: Conex containers, one-quarter ton trucks, two or four A-22 bags, 105 mm howitzers, 500 gallon rubber fuel bladders, damaged helicopters and small airplanes, road engineering equipment and cargo

Above: A CH-54 lifts a 155

Below: A CH-47 lifts ammo

Below: A UH-1D lifts a trailer

Helicopter Slingloads In Flight

nets filled with ammunition or other loose material.

The above loads can be fitted into four categories. The first of these would be compact high density loads producing minimum form drag. An example would be ammunition loaded in the cargo net. The second of these categories would be high density loads of a high form drag producing shape. The loaded Conex container is a good example. The third category would be low density-low drag loads such as empty sandbag bales loaded in a cargo net. Fourth, would be low density-high drag loads such as a damaged UH-1B helicopter with the tail boom removed. Loads in each of these categories exhibit their own peculiar dynamic and aerodynamic characteristics. The remainder of this discussion deals with those characteristics.

An experienced cargo helicopter pilot will have observed that certain external loads behave in certain ways and that there is a maximum speed for each load. Behavior of a given load can depend upon the skill of the pilot, rigging of the load, wind and turbulence conditions and airspeed of the aircraft. To simplify explanation of the dynamic factors affecting load behavior, each factor will be considered individually.

A rectangular solid will be used for this presentation since many loads approximate that shape. Figure 1 shows a side view of a load suspended beneath a helicopter at a hover. Assuming proper rigging and a perfectly stable helicopter, the load would remain in place with weight W and sling lifting force F balancing. If the rigging was not correct or the center of gravity displaced, obviously the load would tilt to establish a new balance point. Closer examination of the figure reveals that we have conditions conducive to starting a pendulum-like motion of the load which is transferred to the aircraft or the load depending on where the motion originated. This is called harmonic motion. If the hover was not stable and the aircraft drifted forward, the load

A UH-1D hauls a bulky Conex container. This is a high density load with a high form drag producing shape

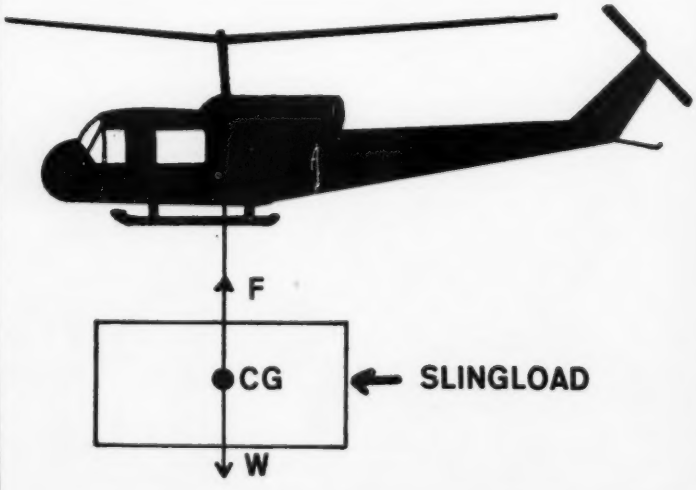


Figure 1 (left): slingload at a stable hover

KEY TO ABBREVIATIONS USED IN FIGURES

CG: center of gravity
F: sling force
W: weight
FV: sling force in vertical direction
FH: sling force in horizontal direction
A: sling angle to the horizon

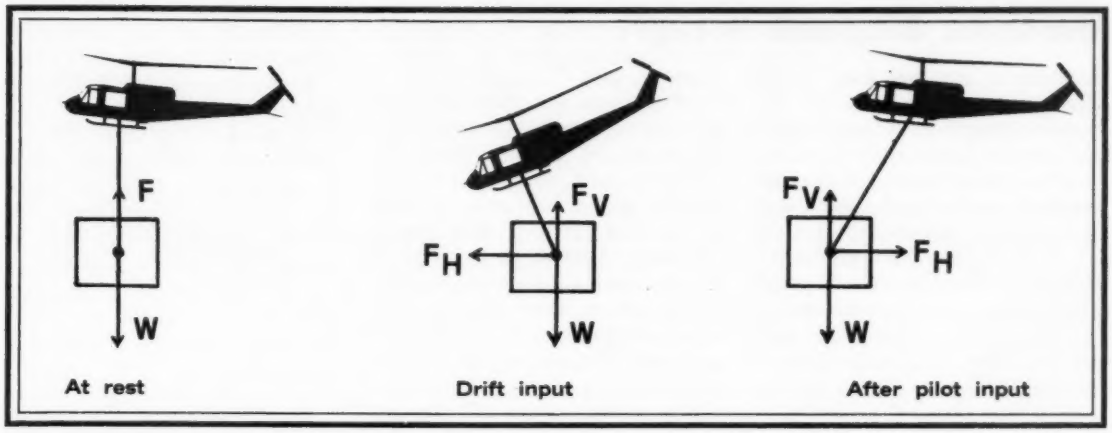


Figure 2: Induced harmonic (pendulum) motion.
Note: Sling forces shown acting at center of load for simplicity

would tend to follow so as to remain centered under the aircraft. The pilot would normally attempt to correct the drift, but some delay would be incurred by pilot and control response times. As the pilot's control movement takes effect, the load has already started swinging forward — now it must start swinging back to regain the new balance. Little imagination is needed to see how a harmonic motion could result. Only fore and aft motions have been mentioned, but harmonic motion could be induced in any direction or even circularly. Figure 2 portrays the conditions.

Another form of harmonic motion is possible. Since nylon slings are normally used for rigging and nylon has natural stretch qualities, the helicopter, sling and load could be considered a dynamic system of two masses connected by a spring (Figure 3). A vertical movement of the helicopter could cause a vertical oscillation of the system. If no further movements were made, the oscillation would dampen. However, if the pilot were to make a control input to correct the original helicopter movement, he could be delayed through pilot and control response times enough to make a movement which would reinforce the oscillation. The effect would be a series of vertical oscillations. These oscillations could cause the pilot's body to oscillate, feeding harmonic inputs to the controls, and resulting in "vertical bounce."

So far, we have considered only hovering flight. What additional forces can we expect to affect the load while in forward flight? As the helicopter accelerates forward on takeoff, one can expect the inertia of the load to initially cause it to lag behind the helicopter until the horizontal component of the sling force causes the load to also accelerate. The reverse would be true upon landing to a hover. More

Figure 3: Vertical oscillating spring

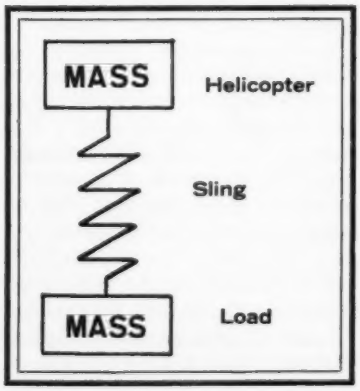
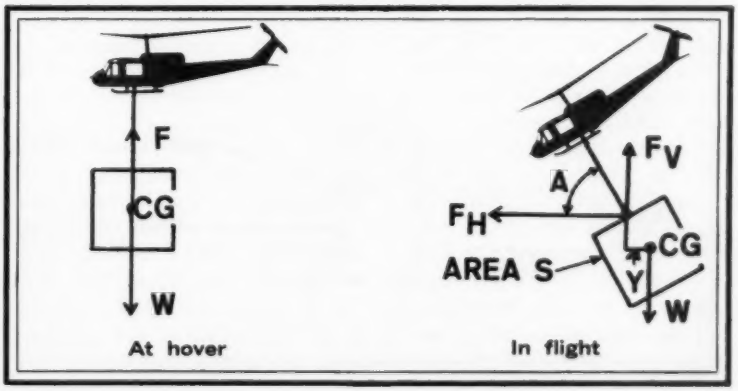


Figure 4: Load dynamic forces



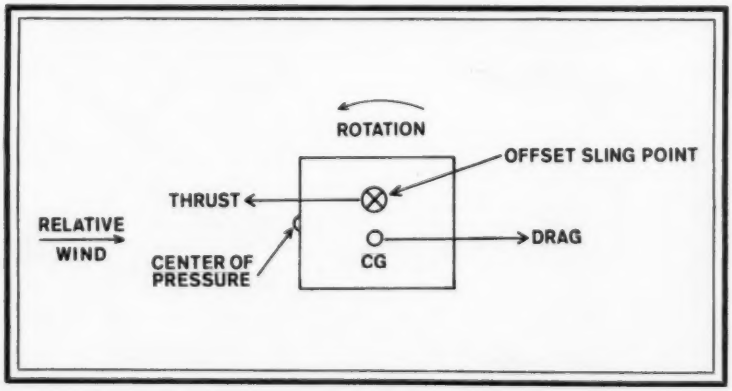
Helicopter Slingloads In Flight

important, as the load moves through the air it will become subject to a drag force. Figure 4 shows the primary forces involved.

The size of drag force D is dependent upon many things. If angle A was 90 degrees, the forward side of the load could be considered a flat plate. The drag force imparted to the load would be a function of air density, air velocity and area of the side. Using the formula $D=\frac{1}{2}pV^2S$ where p is the air density, V the velocity through the air, S the area of the forward side, and disregarding any spillage effects around the edge of the plate, we could calculate the approximate drag force involved. However, angle A would be something less than 90 degrees since the drag force would cause the load to swing back. This change in load position would have several effects. First, the form drag would change from that of a flat plate to a combination of inclined plates. The inclined surfaces would allow easier passage of the air and cause a reduction in drag as angle A is decreased. This would only hold true until the load's top surface began taking on high drag characteristics, of course. We can also see that as angle A decreases, weight W, acting on moment arm Y, would tend to level the load and affect the drag configuration presented. As angle A equals 90 degrees, force FH would be zero, assuming no acceleration of the helicopter or drag on the load. However, drag is present, angle A would be less than 90 degrees and at some point force FH would balance with drag D. Remembering that drag is dependent upon the relative air velocity squared, it is evident that turbulence or other factors affecting the velocity could change the drag force and possibly cause the load to swing fore and aft. In addition, acceleration or deceleration of the aircraft would affect the value of force FH. Pilot initiated acceleration or deceleration of the aircraft, turbulence affecting the aircraft, turbulence affecting the load, or a combination of all three, therefore, could induce load oscillations.

Single point suspension of the load leaves another possibility for reaction to forces. This reaction comes in the form of rotation about the vertical axis. While in flight, drag forces would tend to rotate the load so as to put the greatest area into the relative wind, much as a drifting boat will turn broadside to the prevailing wind. Figure 5, a top view of a load, shows the effect of an offset sling point, which could also cause rotation.

Figure 5: Top view of load



A rotation, once started, can be limited only by a change in forces or by the inherent capability of a nylon sling to reach a point where it will no longer twist. As twist in the sling occurs, the hook-to-load distance decreases and kinetic energy is converted to potential energy until the maximum twist point is reached. The load then rotates in the other direction, giving up its potential energy.

Further examination of the dynamics affecting slingloads is beyond the scope of this discussion and would be quite difficult due to the lack of symmetry of most loads. The explanations given so far are sufficient to establish the fact that a slingload is subject to vertical oscillation, pendulum movements, drag forces, rotation or combinations of these actions. My experience has shown that the Conex container, which is similar to the previously discussed rectangular solid, can be very difficult to handle in flight. This particular container tends to oscillate in all directions and rotates continually while in flight. To prevent twisting of the slings and donut(s) and also to avoid load contact with the aircraft, airspeed must be held at 60 knots or less. Two rubber fuel bladders, on the other hand, can be carried safely at 100 knots or more. A study prepared for the Army by the Vertol Division of the Boeing Company contains load flight and wind tunnel test data which compares favorably to my load experiences. Recently, I observed five CH-47 helicopters working slingloads at a stagefield located at Ft. Rucker. Excerpts from my notes are as follows:

"Aircraft 22121 — Load: Bundle of seven 55 gallon drums filled with concrete (7,700 lbs). Observations: Load followed changes of attitude of helicopter. Load lagged on ac-

A drogue helps stabilize the load, but is difficult and time consuming to rig

celeration, led on deceleration. Pendulum motion, coupled with slight rotation of load, noted.

Aircraft 2425 — Load: same as above less one drum. Observations: Aircraft at hover. Gust from another aircraft caused helicopter to roll and drift left. Lateral pendular action of load noted.

Aircraft 19112 — Load: Fuselage of wrecked small tandem rotor H-25 (2,200 pounds). Observations: Load spun clockwise when lifted from ground. Load then stabilized. Helicopter hovered through turbulent area caused by other CH-47s and load made violent rotations both clockwise and counterclockwise. Load oscillated each time the helicopter changed attitude. On takeoff, load turned broadside to wind. As airspeed increased, load remained broadside but was forced back and up within proximity of helicopter. Further changes of flight attitude caused load oscillations. Load tended to skid to the outside on turns."

The H-25 mentioned is a difficult load although a light one. Instability presents problems that are usually met and overcome by cargo helicopter pilots. Control of the helicopter when hauling external loads under normal conditions requires extra attention to aircraft attitudes, smoother application of control inputs, cautious acceleration to cruise speed and close monitoring of the load. Instrument flight with external loads is very difficult due to instrument lag time and difficulty in determining if an out-of-trim condition is caused by improper control positioning or by load oscillation.

Dangerous situations can arise when unstable loads are subject to abnormal oscillations or rotation. The nylon slings and "donuts" will withstand only limited twisting, rubbing and chafing. Forces on the rigging equipment can exceed load capacities and result in breakage. Contact between the helicopter and the load is very possible and can result in damage to both. Finally, the load can become so uncontrolable that the pilots can no longer maintain control of the helicopter.

No one solution can cure all slingload problems. Proper preparation and rigging of loads is certainly a step in the right direction. Selection of the correct sling length can do much toward reducing vertical oscillations since it has been found that the frequency of these oscillations is a function of the length. Symmetrical rigging would reduce rotational difficulties in some cases. Further refinement of helicopter control systems should help alleviate feedback problems. Four-point suspension, as used by the CH-54, reduces many of the problems but incurs a heavy penalty in load hookup time. In addition, failure of suspension at one or several points places the helicopter in grave danger. Vertol Division of Boeing has run tests on the use of two hooks (spaced 20 inches apart in one test, 4 inches in another) instead of one and had great increases in stability of loads. These hooks were mounted in tandem and side-by-side with advantages gained in either configuration. Another possibility for stabilization is the drogue parachute. The parachutes should be conical in shape and free swiveling to provide minimum drag and maximum stabilization. I observed the use of a drogue chute in Vietnam and noted that rigging this item to the load is difficult and time consuming. Other improvements to stability are bound to be made in the future. Better stability would generally allow an increase in airspeeds and thus result in swifter accomplishment of logistics movements.

Analysis of helicopter slingloads in flight has been presented in general terms. Little research has been done in this area and only several published references are available on the subject. However, external cargo operations with helicopters have proven to be effective and are becoming doctrine in the Army. Improvement of load inflight characteristics will advance the cause of safety and bring rewards of more efficient use of highly expensive helicopter flight time. Further exploration of load aerodynamics could produce some needed solutions to load stability. Much of this work could be done in wind tunnels. Experimentation with different load configurations, with improved rigging methods, and with drogue parachutes should result in better techniques. Just as important, load characteristics should be compiled and published for the use of helicopter pilots so that aerodynamic limitations are not unknowingly exceeded.

At Last, User Oriented

Checklists And Operator's Manuals

Concerning checklists and operator's manuals, there is great disparity between the regulations' intent and what is actually being done. The author points out some good reasons why this is the case and what the Army is doing to improve the situation. His assignment at the Aviation School as Training Literature Officer, Flight Training Analysis Branch, Evaluation Division, Office of the Director of Instruction gives him access to some authoritative insights into the checklist problem area

Major William H. Gardner

IN THE FEBRUARY U. S. ARMY AVIATION DIGEST the article "A Wink, A Nod And A Smile," afforded the reader an opportunity to ride along on a fictional flight from Seoul to Taegu, Korea. Fictional or not, the story of the flight and the pilot's dream of a fatal crash contain a pertinent moral for all Army aviators. This pilot's failure to follow a checklist could have killed him, as he imagined it had. Far more important is the fact that failure to use checklists and other documents aboard aircraft has killed Army aviators and will continue to do so unless all Army pilots can "wake up" as checklist oriented as the aviator in the article.

The presence and use of these documents aboard Army aircraft is required by regulation. And yet, consider the following which is a brief account of a fatal OV-1 crash some years ago. The left engine failed shortly after takeoff and the aircraft went into a roll to the left, lost altitude and crashed in a wings level, 40-degree nose low attitude. The aircraft was totally destroyed and both occupants sustained fatal injuries. Among the cause factors was the fact that the pilot did not make a complete run-up of the engines prior to takeoff in accordance with the operator's manual (dash 10). Had he done so, the accident investigation revealed, the engine would have failed on the ground. A checklist and its use during run-up would have avoided this $1.5 million accident and the loss of two lives.

"The hazards inherent in adequate preflight, takeoff and landing procedures require that special attention be given to the use of pilot and aircrew checklists" (Para 18, AR 95-4). Subsequent paragraphs of this same regulation state that unit commanders are responsible for insuring that up-to-date checklists are available in the aircraft and that crewmembers accomplish verbal callout and confirmation of checklist items.

The operator's checklist (dash CL) and the dash 10, including all changes and related technical bulletins, are required to be located and maintained in the aircraft by Para 3, AR 750-61.

In the area of checklists and operator's manuals, unfortunately, there has been great disparity between the regulations' intent and what is actually being done. There have been, however, some fairly good reasons as to why this has been the case.

Availability of current checklists and operator's manuals is an admitted problem but, with regard to checklists, it is safe to say that aboard most aircraft is a checklist of some sort. It is also safe to say that, aside from the aviation schools, checklists are seldom used. Some pilots fail to use the checklist because they feel it is beneath their dignity. Others do so out of laziness or to expedite a flight and this is really the fault of the commander because this indicates a lack of command emphasis. Some, however, don't use the checklist because it differs from what they were taught and they prefer their memories to different or confusing procedures.

Another problem facing some aviators is being able to discern from the available checklist just which step or procedure is pertinent to their particular series of aircraft. And in the absence of the checklist (dash CL), many will not use the dash 10 operator's manual (even if available) "as a source for the checklist for accomplish-

CHECKLISTS

The long and the short and the tall

(We have them all)

Checklists And Operator's Manuals

ment of each preflight and review of takeoff and landing sequences" (AR 95-4) because it differs in format from what the aviator has previously learned or used. Conscientious aviators have been faced with the following problems, also, because the Army's aircraft checklists have not been standardized in the past:

• They have differed in size and shape. Those printed by the Department of the Army have run generally 5 x 8 inches but those locally reproduced have been as small as 3 x 5 and as large as 8 x 10. They could be found on ringed binders, stapled, stickered or clipped and could have opened like a book or flipped over the top.

• There were as many differences in format as there were in size or shape. The sequence of checks varies from checklist to checklist and the items would be lettered, numbered or just indented. Many checklists contained performance data charts which were difficult to comprehend and not always identical to, although often one quarter the size of, those found in the operator's manual.

• AR 95-4 now authorizes local reproduction "on aircraft for which a checklist is not available or is lost or mutilated." These local reproductions were generally inconsistent with the authorized dash CL and reflected the personalities and the mission of the particular unit.

• Often whole series of aircraft were combined into one checklist. There is considerable difference in the procedures for a UH-1B and a UH-1H for example. No matter how conscientious the writer of such a checklist might be, the resulting document would only tend to confuse all but the most experienced aviators.

• The checklists although supposedly an extract of the operator's manual often were not consistent. This was due in part to the delays associated with getting new procedures and changes to the field. It was due also to a lack of standardized guidance in the preparation of checklists and their relationship to the operator's manual.

Many of the same problems are inherent in our operator's manuals. They, too, are not standardized in content and format. Most operator's manuals present extraneous information far beyond the needs of the operator. There are too many unnecessary charts which clutter the manual and confuse the operator.

If the discussion above, in itself, didn't warrant increased effort and emphasis toward improving the quality and individual utilization of aircraft operator's manuals and crewmember's checklists, two other areas did. The first has been the arrival of new and more complex aircraft. Initial employment of such sophisticated aircraft as the CH-54 Flying Crane; AH-1G Cobra; and the AH-56A Cheyenne has underscored the value of associated operational publications. The second area has been the rapid emergence of numerous weapons and other systems for Army aircraft. The necessary insertion of the checks and procedures for these systems in the checklists and operator's manuals has further emphasized the need to standardize in these areas.

We have just discussed essentially where we in Army aviation have been in the checklist and operator's manual areas. It is obvious that there is a great deal to be done in these areas and during 1968 much was accomplished. Before discussing these advances, it would be appropriate to review responsibilities for the operator's manuals and crewmember's checklists as they are now established:

U. S. Army Aviation Systems Command (USAAVSCOM), St. Louis, Mo., is responsible for the publication of all Department of the Army aircraft operator's manuals, checklists and maintenance manuals.

Equipment Manual Field Office (EMFO), Letterkenny Army Depot, Chambersburg, Pa., is responsible for establishing specifications for aircraft (and other vehicles) operator's and maintenance manuals. EMFO is also responsible for MIL-M-63029 (TM), Military Specifications — Manuals, Technical: "Manuscript Requirements for Operator's and Crewmember's Checklist for Aircraft," or in more familiar language, The DA Writer's Guide. The updating of this document has had a profound effect on all checklists.

The U. S. Army Aviation School (USAAVNS), Ft. Rucker, Ala., has been delegated by the Assistant Chief of Staff for Force Development (ACSFOR) as the primary coordinating authority for:

• Operator's and crewmember's checklist

• The following chapters in the operator's manual:

Chapter	Title
3	Normal Procedures
4	Emergency Procedures
6	Auxiliary Equipment
10	Weather Operations
11	Crew Duties

It is through a series of conferences that USAAVNS exercises the necessary coordination on the various aircraft manuals. All aircraft manuals are subject to review on the following basis (the aircraft in parentheses are current examples):

(1) New aircraft (AH-56) — 90-day interval.

(2) In production complex aircraft (CH-47) — 120-day interval.

(3) In production simple aircraft (OH-6) — 180-day interval.

(4) Out of production aircraft

(U-6A) — based on funds.

(5) As scheduled by contractor depending on product improvement or changes to aircraft.

These manual review conferences are scheduled and coordinated by the USAAVSCOM and normally include representatives from some 15 to 20 activities including, besides USAAVSCOM and USAAVNS, such organizations as the Electronics Command (USAECOM), the Weapons Command (USAWECOM), the Aviation Test Board (USAAVNTBD), the Board for Aviation Accident Research (USABAAR), the aircraft manufacturer and the contractor who will or does publish the manual. Prior to attending any review conference, a pre-conference review is held at USAAVNS which includes representatives from the Office of the Director of Instruction (DOI); the Departments of Advanced Fixed Wing, Rotary Wing, and Maintenance Training; USABAAR; the Aviation Test Board; and the USAAVNS Element when applicable. This system of manual review to include pre-conference reviews at USAAVNS' has already resulted in more user oriented operator's manuals.

Until recently USAAVNS has used its own series of checklists. USAAVNS did not utilize Department of the Army checklists because the then prescribed content, sequence and format were not considered suitable for the USAAVNS mission. The checklists used were for the most part locally produced by USAAVNS and used for training only. They were rough extracts of Chapters 3 and 4 of the often outdated operator's manuals (for which USAAVNS is now the prime coordinating authority). These checklists did not prove to be standard between or even within departments. Emphasis on the memorization of checklists by student aviators also tended to minimize the requirement for standardization of checklists and contributed to failure in the field to follow the provisions of AR 95-4 quoted earlier. Lastly the old series of USAAVNS checklists were often too detailed for use in the field. The USAAVNS checklists tended to explain rather than enumerate a particular item for its student aviator user.

Employment of sophisticated aircraft such as the CH-54 Flying Crane (above) has underscored the value of associated operational publications

During 1968 many corrective "giant-steps" forward were taken to standardize operator's manuals and crewmember's checklists. These steps included:

- The Commandant, USAAVNS, has directed that students no longer be required to memorize checklists but rather only those initial emergency procedures that must be accomplished without hesitation. It was directed at USAAVNS and will be further emphasized in Army regulations that the checklist will be used at all times for all aircraft.
- USAAVNS will no longer publish a locally developed checklist and has adopted the Department of the Army checklist for use by its students and permanent party personnel (thereby eliminating costly checklist duplication).
- The DA Writer's Guide has been updated and will be applied to all operator's manuals and crewmember's checklists. As a result a more practical, more accurate and less redundant checklist has been developed, suitable for student training and applicable to each type, model and series of aircraft. It is standard in size, format and content and is written for operators by operators.
- Terminology has also been standardized. There will no longer

Checklists And Operator's Manuals

be a dash 10 CL nor will the term be used. Instead the term "dash CL" will be used for all crewmember's checklists and the operator's manual will continue to be referred to as a dash 10.

• The new checklist will be of a size and format that can be used in TM 1500-1. This ringbinder, containing 60 plastic inserts, is specifically designed to hold the new checklists. TM 1500-1 is authorized on the basis of one per Army aircraft worldwide and is available to aviation units in Vietnam.

• The majority of performance data charts have been removed from the checklists since they are also found in the dash 10 which by regulation should be aboard each aircraft. In addition, a project has been initiated to convert performance data charts to graphic presentations for both the checklists and the manuals which will further reduce the volume of both documents as well as present the necessary information in a more readable and useful form.

• Increased emphasis has been placed on securing from the individual user direct reports of any errors, omissions and recommendations for improving crewmember's checklists and/or operator's manuals. DA Form 2028 has been designed for this purpose and should be used for reporting improvements. The form may be forwarded direct to either the Commanding General, U. S. Army Aviation Systems Command (USAAVSCOM), P. O. Box 209, St. Louis, Mo. 63166, ATTN: AMSAV-M, or the Commandant, U. S. Army Aviation School (USAAVNS), Ft. Rucker, Ala. 36360, ATTN: AASDI-E. The above information will be found in the front of all new checklists and operator's manuals as well as in the new AR 95-4. Look for some major changes in the new AR 95-4, due in mid-1969, with regard to local reproduction of checklists and use of the Department of the Army published checklists.

On 31 Jan 69, updated DA approved checklists were scheduled to be available for the following aircraft:

UH-1A, B, C, D and H
AH-1G
CH-54A
CH-47A, B and C
OH-6
O-1A and E
U-8D and F
U-21

Primarily due to the advent of more sophisticated aircraft and increased employment of weapons systems, the new dash CLs reflect several changes in organization as compared to previous checklists. A future article in the DIGEST will outline the format and highlight the changes in the updated operator's manuals and crewmember's checklists.

Army Seeking Quiet Helicopter

THE U. S. ARMY Aviation Materiel Laboratories (AVLABS), Ft. Eustis, Va., has awarded contracts to Kaman Aircraft ($173,000) and Sikorsky Aircraft ($375,000) for their participation in a Quiet Helicopter Program.

Richard C. Dumond, AVLABS project engineer, Applied Aeronautics Division, noted that the purpose of this program is to obtain the maximum reduction in the external noise level of an operational helicopter.

The Quiet Helicopter Program is sponsored by the Advanced Research Projects Agency (ARPA), an operating entity attached to the Office of the Director of Defense Research and Engineering in the Office of the Secretary of Defense.

The participation by each contractor will consist of a two phase effort. During Phase I, all the work necessary to "quiet" the helicopter will be accomplished. Next the helicopter will be delivered to Wallops Station, Wallops Island, Va., for Government evaluation. In addition, a standard or unmodified helicopter of the same model as the modified helicopter will also be delivered to Wallops Island.

For comparison, both the standard and the modified helicopter will be flown over a predetermined instrumented course to measure and record their noise level. The Kaman HH-43B and Sikorsky SH-3A helicopters will be used in this program. Testing at Wallops Island is scheduled to begin this month.

The Government evaluation at Wallops Island will be under the supervision of AVLABS with the helicopters being flown and maintained by the contractors.

All noise level measurements during the Government evaluation will be performed by the National Aeronautics and Space Administration (NASA), Langley Research Center, Langley Air Force Base, Virginia.

Do You Understand?

You must know and understand the fundamentals of your aircraft and its operational environment

WO1 Wayne K. Roberts

IT WAS A BEAUTIFUL day in August 1963. We were clattering along in a CH-21 Shawnee at 1,500 feet over "D" Zone, about 40 miles west of Bien Hoa.

"Engine failure!" yelled the pilot as he bottomed pitch.

There was no opening in the jungle below. The only place we had to go was the tops of 200 foot trees.

As I looked out the door for any area that offered a chance, I noticed the exhaust stack was still shaking around as it normally did under power. I turned, saw the engine to mid-transmission drive shaft was turning and yelled, "It's still running!"

The copilot came in with, "We have manifold pressure, oil pressure and cylinder head temperature."

The pilot pulled pitch and we climbed back into formation. This turned out to be just a small embarrasing incident to the pilot. Imagine, thinking the engine had quit just because the engine tachometer had failed! We had recovered 300 feet above the trees — just 300 feet from disaster. Why? The pilot didn't scan his instruments or use the training he had received. What if he had been flying solo?

Two years later a friend of mine flew an O-1 until the engine froze up. Ten minutes before it quit, the engine and firewall got so hot that it was uncomfortable to keep his feet on the pedals. He was surprised when the engine quit. Unbelieveable? Yes, for he was, and still is, considered a good pilot.

Cause? No safety pin in the oil filler cap allowing loss of the cap and oil. Inadequate preflight, no instrument scan and in other words, not watching what he was doing.

Three years later, a student pilot was flying a loaded UH-1D out of a landing zone in Georgia when he heard the low rpm audio and saw the red light. The low rpm audio and light were written up for coming on intermittently on the dash 13. His action? He rolled the throttle off and planted it in a pea patch resulting in a hard landing and an aircraft down for two months. He had flown the aircraft

Do You Understand?

for four hours prior to the accident but did not remember the previous writeup and made no instrument scan — neither did his copilot.

It's obvious by now that not everyone makes the instrument scan he should. The relationship between related instruments is as important as individual instrument readings. But before the instrument group can be interpreted, you must understand the basic system operation. When you get an abnormal indication, do you know if it's a system trouble or an indication trouble?

For instance, you have a fluctuating exhaust gas temperature gauge. With all other indications normal, you can be sure that it is in the indicating system. But what if the torque and N1 are fluctuating also? Could this be a faulty A.C. power source? No. Two of the three instruments generate their own power.

The dash 10 will tell you what to do when the engine quits. But how do you know when it's going to quit? How do you know it has? What can you do if it hasn't quit completely — and is it safe to do it? What are the odds? You can't answer these questions unless you understand the theory of operation of the particular system.

Have you ever tried posing problems for yourself? Like, what if you're running up a UH-1D on the ground with no intention of taking off. Suddenly, the aircraft lurches into the air. After gaining control, you find you have a 2,000 foot per minute climb with the collective still on the floor. Now, you're up the proverbial creek with inadequate locomotion (or with too much paddle?).

First of all, it's obvious that you have a control disconnect in the collective pitch system. O. K., where could it be? You can divide the control system into three subsystems: the rotating controls, the power boosted controls and the mechanical system from the control sticks to the boost actuators. Let's take them one at a time:

- If it were in the rotating controls, we would have lost cyclic control along with collective control. True? True.
- If it were between the hydraulic actuator and the rotating controls, we would still have cyclic control. True? True.
- If it were between the control stick and the hydraulic actuator, we would also have cyclic control but no collective control.

Well then, it's not in the rotating controls, but where is it and what can we do?

If it is above the hydraulic actuator, turning the hydraulics off probably will not help, but try it — it just might. If it doesn't, what then? There is no point in climbing until the engine quits. How to stop climbing? There's forward airspeed but what then? That leaves bank. Which way? In a UH-1, a right bank with plenty of pedal will take the most power from the engine and rotor system. With enough bank, you can even come down. This is going to put you in a hairy bank, out of trim, but coming down. Now is the time to look for some place to put it. It's obvious that we are going to need a large field. This means rolling out close to the ground and immediately cutting power to stay down. But, isn't it a better choice than having the engine quit at 18,793 feet, 6 inches and watching the rotor rpm bleed off?

If, when you turn off the hydraulics, the rotor goes to flat pitch, you're in business. All you have to do then is shoot an autorotation, turn the hydraulics on at the bottom and roll off the engine.

Pretty farfetched? It can happen.

The problems you pose for yourself can start with simple questions. How do you tell an engine failure from a rpm governor failure? If this instrument gives an abnormal indication, which other instruments and lights can I crosscheck? What do you lose if the A. C. power source quits? Which instruments have self-generating power? What do you do if you have a plugged static system? How much is excessive oil consumption for your aircraft engine? What is likely to be an instrumentation error rather than a system malfunction? And last, but certainly not least, what information is required on the writeups?

The following are actual pilot writeups found on a series of dash 13s. The type of aircraft is UH-1, but similar writeups have been found on aircraft since the Wright Model "A":

- Pilot's pedestal radio inop
- Pilot's needle inop
- Standby compass reads 300 degrees off
- Low power
- Engine rpm bleeds off
- Aircraft is not light on skids at 17 PSIG torque at 6600 with outside air temperature at 35 degrees centigrade

What information is missing and which writeups indicate inadequate knowledge of the aircraft and system checks? Remember, aircraft and engine performance changes with changes in temperature and altitude. If you're in doubt, write it up. But learn what information will be required by maintenance personnel for them to make a determination without having to test fly the aircraft.

Writeups, such as those given are funny but they don't develop an appreciation of the pilot's sense of humor by the maintenance personnel. In other words, you're being laughed at, not with.

Ten years ago, Major James B. Tyson, USAF, while flying a C-97 out of Travis AFB, Calif., to Hickhan AFB, Haw., lost both engines on the left side. Numbers one and two for you multi-engine types. He had a full load of passengers, two good engines on the right side, troubles to spare and an intimate knowledge of his aircraft capabilities and general aerodynamics. A quick check of his fuel consumption at max power on the two good engines showed that he would run out of fuel about 300 miles short of land either way he went.

There are two ocean weather station boats about halfway between California and Hawaii. Two months before, a Pan American Strato-Cruiser (C-97) with two engines out had ditched without loss of life, next to one of these ocean stations. MAJ Tyson had found a different solution in the span of time from the Pan American ditching to his own difficulties. He had found that over long stretches of open water about 100 feet above the water there is a layer of dense air. He also found that by descending slowly, until there was a sudden increase in airspeed, he could hold that altitude, and reduce power considerably while maintaining his original airspeed.

By flying on top of this cushion of air, MAJ Tyson flew to Hilo, Haw., and made a go-round when he wasn't satisfied with his first approach. The boundary layer of air he discovered and used is now known as the "T" effect. Several months later, a pilot in a light twin over the Great Lakes used the same effect to get home. You don't have to make an original discovery to be a good pilot. But you do have to take advantage of them. And to take advantage of them you must know and understand the fundamentals of your aircraft and its operational environment.

I've had the principles of fixed wing and rotary wing aerodynamics many times in the last 15 years. I've worked in aircraft maintenance continuously for 15 years, yet about once a year I have to sit down and bone up on them. I have to do the same thing with the principles of reciprocating and gas turbine engine operation, hydraulics and electrical systems. I don't really understand electricity but I know the power sources for my aircraft instruments and the options I have if one system doesn't operate as advertised.

Do you

Understand?

Aircraft Recovery In Vietnam

Lieutenant Colonel Emmett F. Knight

HELLO SAIGON Tower; Goodnature Six for takeoff — recovery, over."

"Roger Goodnature Six; you are cleared to hover to the helipad and you're cleared for immediate take-off. Use runway one-eight. Winds are one-two-zero degrees at 10 knots."

"Roger; Goodnature Six is on the go and switching frequencies at this time."

The cryptic radio conversation you just read is one that has been recorded by the control tower at the Saigon Helipad nearly every day for the past three years. It is the Goodnature recovery ship of the 56th Aircraft Direct Support Maintenance Company initiating take-off to rig and coordinate the recovery of another downed aircraft.

The recovery of aircraft which have been forced down in unfriendly territory is a mission which is performed daily, often several times a day, by aviation maintenance units in Vietnam. U. S. tactics rely heavily on helicopters and fixed wing aircraft to perform a great variety of tasks over enemy controlled or contested territory. When an aircraft is shot down, crashes, or is forced to land, it must be recovered and the 56th alone recovered over 350 downed aircraft last year.

Barricaded in near the 56th maintenance hangar is a UH-1D utility helicopter. This Huey sports a variety of signs which tell its history. On the copilot's door is the legend "Rice Paddy Daddy" and on the pilot's side a sign in large block letters states "Goodnature." On the nose is painted an animated, machinegun toting, bulbous-nosed Huey, dangling cargo straps and hooks from the skids and carrying a sledge hammer and wrench in either toe cap. This caricature has a ferocious expression on its face, a cigar in its mouth and a business-like manner overall. A message is emblazoned around it which states the mission in succinct terms; "You Crash and Call — We Dash and Haul."

The recovery team is organized around the UH-1D. It is the rigging ship and carries the team, tools and equipment required to prepare a downed aircraft for lift. It provides weapons for fire support while on the ground and the radios necessary to control the operation.

What follows is a brief description of the recovery of a damaged helicopter, a normal mission for Goodnature. Some of the radio transmissions which would be heard on a typical mission are included to illustrate the complex coordination required.

Goodnature often begins its mission from the air when the team has been prepositioned to support a large heliborne assault. This system is used when the probability of downed aircraft is high and the tactical situation demands their immediate removal from the battlefield. A more normal mission would begin with a radio or phone call

to the operations officer. This request includes all necessary information: type of aircraft, location, extent of damage, security situations, etc. It is logged in on a form designed to limit the possibility of error in taking the mission. The recovery officer is notified immediately and begins his planning. He makes a thorough map reconnaissance, does some rapid time-distance planning and places a call to the unit supplying the Chinook. He will pass the mission, including a time on station which he has worked out, to the Chinook unit control station; in this case the call sign is "Crapshooter."

"Crapshooter Control, Goodnature Control; recovery mission, are you ready to copy? Over."

"Roger Goodnature; send your mission."

"Roger; we've got a UH-1D down near Tay Ninh; grid coordinates XT593620. It's a Robinhood ship, tail number 66-12548, severely damaged but still upright. It's in the trees so be prepared to hang on some extra length of sling. We have layed on a light fire team and ground troops are in the area. A minimum security situation; must have it out prior to dark. Request Crapshooter be on station at 1640 hours. Contact Goodnature Six on unit frequency, VHF. Confirm time and grid coordinates, over."

"Roger Goodnature, Crapshooter 072 will be on station at XT593620 by 1640 hours, over."

The copilot, meanwhile, has the recovery helicopter wound up and takeoff is initiated within minutes after the mission is received. The flight plan is opened and radar monitoring is requested. Artillery advice is checked periodically along the route:

"Hello Square Lobster Control, say artillery for flight route Saigon to Tay Ninh, over."

"This is Square Lobster; we have negative artillery firing your route of flight."

As the flight progresses into the area where the downed aircraft is located, contact is made with the ground forces operating in the area:

"Red Dog Three Zulu; this is Goodnature Six, over."

"Roger Goodnature Six; this is Red Dog Three Zulu, over."

"Roger Red Dog; we're presently approaching your area to recover that Robinhood Huey, estimate arrival his location in one-zero minutes, over."

"Roger Goodnature; been expecting you. We've got troops in around the Robinhood helicopter and a Crossbow light fire team in on station, no reported enemy contact lately, over."

"Roger; thank you much, out."

The troops at the site are contacted and report on the exact situation as final approach is initiated. The Crossbows, a pair of armed UH-1D gunships, are contacted:

"Hello Crossbow; Goodnature Six is on final approach to the downed aircraft."

"Roger Goodnature Six, this is Crossbow Two-Six; we'll cover you, better avoid that open patch on your left. That's where 548 got it, over."

"Roger Two-Six; we're expecting our Chinook in one-zero, we should be ready to go by then."

Crossbow Two-Six answers as the crew departs the Goodnature Huey to begin rigging. Eyeball to eyeball contact is made with the ground unit commander to talk over the situation. Soon Crapshooter 027 arrives on the scene and is called in to make the pickup. He received advice and assistance from the recovery officer while on approach, as the rigging crew completes the hook-up and during departure from the area. All elements are then notified that the extraction has been completed and the gunships are released. Goodnature escorts the Chinook with its slingloaded Huey to home station and the mission is complete.

This was a "normal" mission; very few are actually like this, most will be a great deal more involved. Enemy action, a helicopter which is rolled up in a little ball, a late Chinook or out-of-gas gunships; these and many more are the elements which make recovery a challenge, every time.

In front of the 56th maintenance hanger, stands a line of armed UH-1B and C model gunships and UH-1D troop carriers. Among these helicopters awaiting repair, there are always several severely damaged ones; helicopters with broken tail booms, missing rotor blades, torn out rotor heads and transmissions; some with damaged engines and some with doors, windshields and plexiglass windows broken out. Many of these badly damaged helicopters will have holes caused by small arms fire stitched along the side or scattered indiscriminately across the cockpit and fuselage. Some will be full of the debris and covered with the rice paddy mud of the crash. These wrecks have seen their share of war and they appear to be excellent candidates for the bone yard. Sometimes this is true, and after the removal of valuable components, their last flight will be made, slung under the belly of a Chinook, to the salvage yard at Vung Tau. The majority of these badly torn up warriors, however, will be repaired at some level in the maintenance support system.

Nearly every aircraft which crashes, is shot down or forced to land in enemy controlled or contested territory will be recovered for repair or salvage. The effort will be coordinated by this direct support unit or by one of several others like it located throughout Vietnam. The savings in money and material are tremendous.

Observations Of A Scout

Captain Richard L. Greene

THE SCOUT MISSION to that point had been uneventful. The two OH-13 scout ships were low level over the trees of War Zone D, about 15 miles north of Bien Hoa while two gunships circled overhead. All four aircraft were from Troop D, 1st Squadron, 4th Cavalry, 1st Infantry Division. The morning was fair following heavy showers the previous evening.

The two scout aircraft broke out over a large grassy expanse marked on the map as the "military area." To their left the outline of an old triangular fort could still be seen where two dirt roads intersected. One of the dirt roads ran north from the fort and, as the lead ship reached the road, the pilot brought the aircraft around in a tight right hand orbit. There, visible in the fresh mud of the last night's rain, was a set of tire tracks. The tight right hand orbit was more for thinking than for looking. This was Charlie country and there was no doubt who had made the tracks. Intelligence reports said the road was being used to carry rice to the hard core VC units to the northeast. Chances were good that the truck was hidden somewhere in that direction. If so, it would have to be closeby for its radius of action would be limited by the Song Be River about 4 miles distant. Furthermore, the cover was sparse up that way so it might be possible to find the vehicle.

The lead scout ship informed the other aircraft of the tracks and started following them. With about 50 knots of airspeed and an altitude of 6 to 10 feet over the road, he could see the tracks well enough to hopefully find a turnoff point. The second scout ship took up a loose wing position to the left rear of the lead so that his gunner-observer might provide some cover.

The two bravo model gunships followed at altitude. Within a mile the tracks suddenly ended. Just as they did, the lead ship's observer asked the pilot to come around right. There under a growth of arching bamboo, faintly visible was a large dark bulk. The observer already was firing his M-16, 20 rounds at a time, into it. Within minutes smoke was on the target and the gunships were firing.

The previous incident is not an isolated case. Tracking the enemy

The scout ship is a little aircraft with big friends that make it an extremely formidable and effective weapon

is a time honored cavalry technique currently being used with effectiveness by modern aero scouts in Vietnam. The tracking technique can be especially effective following rocket and mortar attacks by enemy units on friendly base camps. The VC frequently use a rather standard pattern for conducting such an attack. Starting at dark they will march to a selected point within range of the target. Next they will proceed to dig in to provide cover against counter battery fire. Often they are dug in, ready and commence their shelling before midnight, leaving considerable time for escape. Starting at first light, a scout can begin searching for the mortar or rocket site. A good knowledge of the ranges of the VC weapons can be helpful. For instance, if shelling was with an 82 mm mortar, the scout can expect the mortar site to be within 4,400 meters, the maximum range of the mortar.

The technique of tracking from the launch site was used effectively following a rocket attack staged by the VC on the U.S. base camp at Phuoc Vinh in July 1967. Working from 1,500 feet of altitude, scouts were able to find the launch site after about an hour and a half of searching. Before leaving the site, the VC had taken care to camouflage their diggings, but enough freshly dug earth was visible from altitude to arouse the curiosity of the scouts. A quick low level check confirmed the launch site. The site consisted of a row of three mounds of earth used for launching the rockets. It was located in a clearing 7 kilometers north of Phuoc Vinh. In front of the mounds was a shallow hole where an aiming device had probably been emplaced. In the adjacent tree line were 30 or 40 foxholes, many with overhead cover. Freshly cut boughs had been stuck into the earthworks in an unsuccessful attempt to camouflage them.

Direction of the VC departure was determined by tracks on a nearby trail. (Tracks, of course, lead in both directions, but it was assumed that the VC had withdrawn further away from Phuoc Vinh.) The trail was followed from

Observations Of A Scout

altitude to a heavily wooded area from which there was no heavy volume of tracks exiting. A "people sniffer slick" working the same area confirmed the likelihood of this particular wood patch. Finally the VC were obliging enough to fire on the scouts to confirm their position for the gunships and the Air Force.

In a general way, tracking can be useful in locating active VC base camps. Relative numbers of tracks on trails and the age of the tracks can give a fair indication of which areas are hot and which are cold. The scouts follow the small trails that lead off the major ones or just nose about the woods adjacent to the heavily traveled trails. The first indication of a base camp will often be the disappearance of heavy undergrowth beneath the tree canopy. A patch of bare ground on the forest floor is a sure tip-off. Tight circling to get the best views through breaks in the canopy will usually at this point start to reveal trench lines, tunnel openings, bunkers and maybe some thatch roofs. Signs of an active camp will be the condition of the earthworks, and glimpses of clothes hanging to dry, chickens, dogs and people. Such indications are generally visible for only the briefest split second while passing foliage breaks at reduced airspeeds. One of our pilots actually had occasion to observe a Viet Cong peering back at him with a rifle in his hands. In spite of the ostensible vulnerability of the scout ship in such situations, fire from base camps was seldom received. (This is based on experience between September 1966 to September 1967.)

Here are several other possible tip-offs as to the whereabouts of enemy base camps. Occasionally the VC use tin sheeting covered with thatch for roofing their hooches. Under ideal conditions it is possible to locate a camp by the reflection from such a roof providing there is a hole in the camouflage. In isolated areas along rivers and streams one may be surprised to spot foot long sections of bamboo floating in a row by the bank and not drifting with the current. These are bobbers being used by the local VC for their fish traps. Of course, isolated garden patches in Charlie country are again an indication that close by VC are attempting to augment their diet. Where defoliation had exposed a base camp necessitating Charlie's withdrawal, green patches close by will sometimes show he hasn't moved far.

While reconnaissance is the chief function of the scout, his job is far from over when he finds a VC camp or unit. The scout himself is in the best position to exploit the intelligence data that he has just obtained. He often works in remote areas where subsequent action by friendly ground troops is unlikely if not impossible. Timewise, the scout is the first man on the spot when time is an important factor. Delay gives the enemy time to react and escape so immediate action by the scout is essential for maximum exploitation of the target. If the scout doesn't take steps to exploit the target, often no one else will get the chance.

Pilots who have had the opportunity to see a VC base camp from the ground will vouch for the fact that they are tough nuts to crack. The VC spare no effort to be properly dug in. In addition to trenches, bunkers and tunnels, the VC are fond of a bunker-hooch combination. It consists of a hole in the ground covered over with logs and a foot or more of hard packed earth. This thick bunker roof is raised slightly above ground level leaving room for firing ports so they can fire horizontally while ensconced in their bunkers. Directly on top of the bunker roof is built a hooch usually with a thatched roof. In the event of trouble a Charlie can literally roll out of bed into the relative safety of his bunker. The 2.75 inch rockets and 7.62 miniguns are of limited value against such "hard" targets. Artillery, liberally applied, and airstrikes are more effective.

One aspect of reconnaissance operations which is seldom discussed, but is of critical importance is that of marking the target. The difficulties involved in marking deserve a good deal of attention.

Consider the following incident: A scout team with gunship cover was conducting a screen in connection with a troop lift of the 1st Division Infantry several miles north of Ben Cat in August 1967. The area of the screen was laced with base camps, some abandoned, some active. Finding some entrenchments visible among the trees, the lead scout ship went into a tight right orbit to enable his observer to recon by fire, with a hand held M-60 machinegun. The wing ship circled wide. The small camp was sprayed liberally with negative results. Breaking out of the orbit, the lead ship headed south inside and parallel to a tree line. Within 300 meters he received heavy fire from directly beneath him and took three hits. The fire came as a complete surprise and no smoke was thrown. The gun team above, hearing the scouts call "receiving fire," rolled in and hit the forest line with unknown results. Had the scout thrown out smoke the VC location would have been more closely pinpointed for accurate return fire.

There are several other points to be gained from this incident. It clearly demonstrated that the old tactic of reconnaissance by fire is effective in inducing the enemy to disclose their positions. It shows

that a gunner who is ready to fire is probably not ready to mark. In addition, the chatter of an AK-47 is not conducive to presence of mind, so that if the observer is not ready with smoke, forget it. During Operation Junction City in War Zone C, we had the lead ship of a scout team pass directly over a platoon of NVA in thin jungle. He made a radio call immediately but his observer didn't get a smoke out until they had passed the NVA. The wing ship, about 100 yards behind, dropped smoke as soon as he heard the call and broke out 90 degrees to avoid overflying the Charlies. With one smoke on either side, the target was bracketed for the orbiting gunships but of course one smoke right on the money would have been better.

A number of situations of this sort suggests that smoke grenades on bomb shackles might be a better answer. A pilot equipped with a "panic button" on the cyclic for instant release of smoke would be in a decidedly better position to mark accurately. Furthermore, the gunners would not have to divide their attention.

Smoke may not necessarily be the only answer and there are a number of problems associated with its use. On still, wet days it is slow to come up through trees and may not even come up at all. When there is a wind, it drifts, which of course reduces its effectiveness for providing an accurate aiming point. Probably the most serious charge that can be leveled against it is its extremely transitory nature.

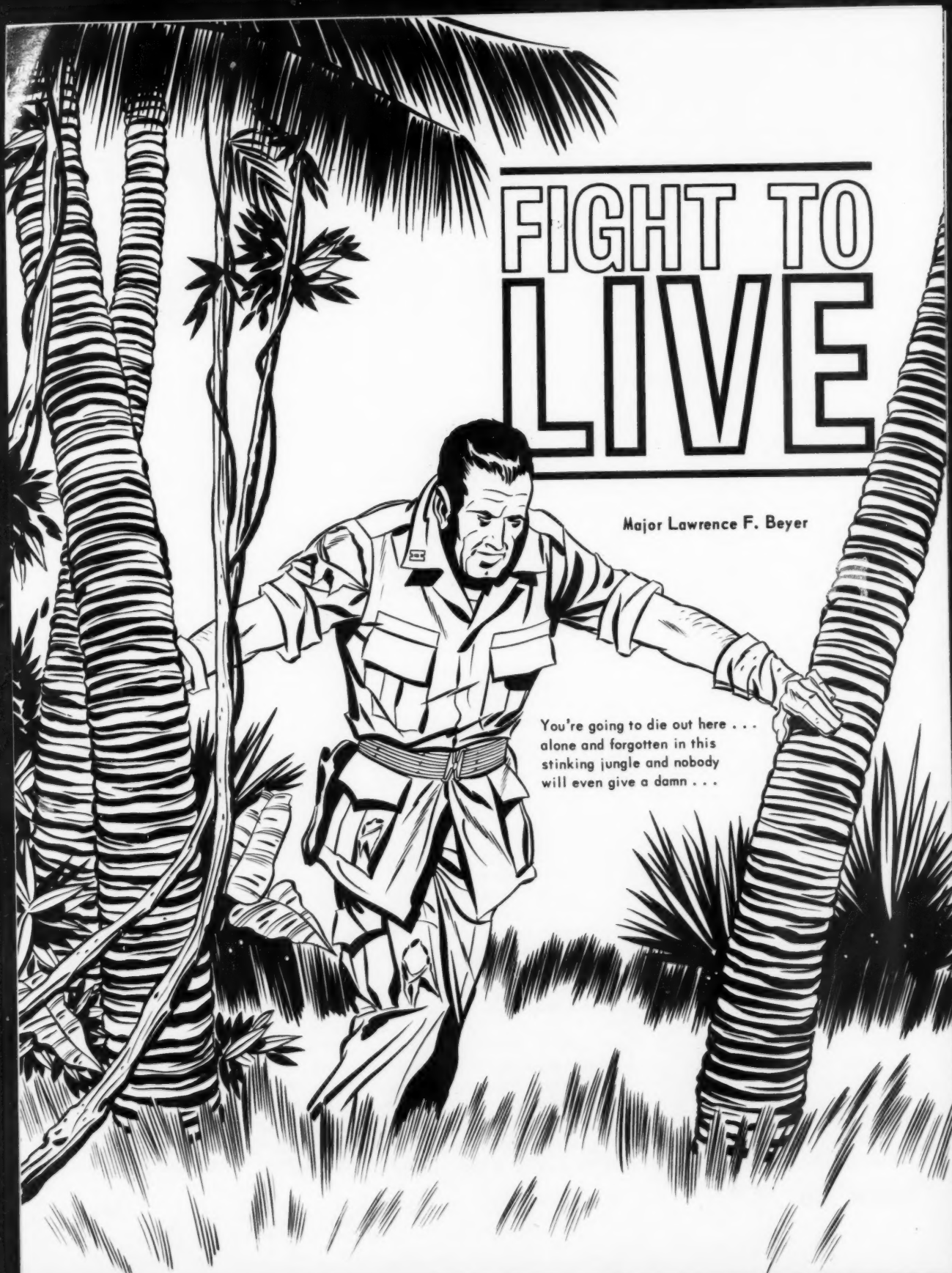
Consider the case of the scout who spotted a small vehicle, a quarter ton or a three wheel Lambretta through an opening in the forest canopy in War Zone D. He circled a number of times but only once or twice again did he catch a glimpse of the vehicle. He dropped smoke and turned his back to the target climbing out as his gunship cover started making firing passes. By the time he was to altitude, the smoke from the grenade was gone but rockets exploding in the tree tops gave a general indication of the truck's location. "How does that look?" asked the gun pilots over the Fox Mike. The scout of course, couldn't say. This was his first time seeing the area from altitude and his best reference, the smoke grenade, had disappeared from the rather featureless sea of tree tops. After the gunships had expended, the scout went low level again, this time he was unable to relocate that certain break in the canopy or for that matter, the VC vehicle.

Another case is equally illustrative. The 271st VC Regiment was plotted by intelligence south of Phuoc Vinh in War Zone D generally east of the village of Phuoc Hoa in July 1967. A scout team was working alone over some low thick jungle when one of the pilots caught sight of some fresh earthworks. Making low level orbits, he lost the position before he could get co-ordinates. Working that same area persistently, he was able to relocate the earthworks three days later and determined it to be an active base camp. The camp was marked for tac air and on one bombing pass, a fighter pilot reported people moving about the target area. Several more sorties were put in. The bombing opened up the foliage revealing an even larger camp than was at first suspected. In all, 11 sorties plus artillery were necessary to fully exploit the target. Denuded of its foliage concealment, the camp was exposed as a radial bunker complex; a large circular perimeter of bunkers connected by trenches, with a large command bunker at the circle's center, connected to the perimeter by radiating spoke-like trenches. The lesson here is that for lack of a semipermanent means of marking some trenches, this large base camp almost escaped unscathed and would have escaped except for the dogged persistence of that scout.

One more type of situation should be mentioned as regards the transitory nature of smoke. Often it is necessary to mark a small or point-type target for a forward air controller, whose sorties are not yet available. Flying low level, a scout has to "lag" the target with his smoke to prevent his airspeed from carrying the grenade long. This takes some "guess and by golly" and doesn't usually result in point-type accuracy. The FAC at altitude then marks the spot on his map and later that day he marks with his white phosphorous rocket for the fighters. Do they hit the target? Very unlikely. The margin for error is the error of the scout's grenade plus error of FAC's rocket plus any aiming error the fighters make. It is pretty hard to hit a truck that way.

Perhaps the best answer to the problem would be a dye marker of semipermanent nature or a smoke-dye combination. If rigged on shackles and released by a "panic button" in the cockpit, it would be a marked improvement over current methods. Throw in a rudimentary bomb sight for marking from altitude and scouting operations would probably run a bit more smoothly.

The scout ship, be it OH-13, OH-23 or LOH, is a little aircraft with big friends. Its superlative observation capabilities, combined with the fire support available to it, make it an extremely formidable weapon. Its mobility makes possible frequent and effective thrusts into enemy country that would be impossible for ground troops to match. Wide ranging scout missions of the type being performed in Vietnam today are truly "raids" in the finest cavalry tradition.


FIGHT TO LIVE
Major Lawrence F. Beyer
You're going to die out here . . . alone and forgotten in this stinking jungle and nobody will even give a damn . . .

crash sense

the following 28 pages prepared by the United States Army Board for Aviation Accident Research

DAMN, HOW HIS back hurt! To stand was agony. Each step was a supreme act of will. How long had he been walking? Days? Weeks? No, it had only been four or five hours since he set out from the crash. But he had never in his life been so tired. It was like the last 440 yards of a mile run. Muscles feeling like lead and screaming in protest. Breath coming in sharp gasps. Down to the finish line. Just a little more effort. Give it just a bit more for the coach. Kick! Go it on guts alone, but keep going. Don't quit!

But there was no finish line ahead of him — just elephant grass. And this wasn't a high school track meet. It was Vietnam and he was lost and hurt and tired and scared. Please God, let me wake up and make this all a bad dream. But he knew it was not a dream. It was real. He was living this nightmare. The panic that he had been fighting against welled up in him again. You're going to die out here! You're going to die alone and forgotten in this stinking jungle and nobody will even give a damn, except maybe your wife. Even your kids won't remember you in a few years. No! I'm not going to die! I'm going to live. I'm going to keep putting one foot in front of the other until I walk out of here. I'll go it on guts alone. But I'll make it.

It started on a beautiful morning. Bright and clear and warm. The kind of a day you felt good just being alive. It was Armistice Day, November 11. They call it Veterans Day now, but he always thought of it as Armistice Day. It was a quiet morning and he had been writing a letter home when the call for his gun platoon had come from operations. It was nothing special, just a simple little escort mission. They'd done the same thing dozens of times. True, this was kind of a short fuse mission. But that was no reason to be apprehensive. It had happened before and would probably happen again. This time a Special Forces strike force had gotten itself into a jam and the crunchies were going in to help them fight their way out. D Troop of the Cav Squadron would supply the escort for the slicks. That meant his weapons platoon.

He was proud of this platoon. It might not have been the best gun platoon in the highlands, but it was a comer. Give them a few more months in country and they'd be as good or better than the best. Starting off had been rough. They'd been green, but they had learned. They listened to what the old heads in neighboring units had to say. They hadn't had to pay in blood for their mistakes. Now they were honed to a fine cutting edge. They were a team. They flew as a team and fought as a team. Yes, he was proud of them.

"Bushwacker Six and flight. Cleared takeoff."

Gently, ever so gently, start hovering forward. Don't lose rpm. Baby it! Two feet above the grass, 18 inches. There's 6400 rpm. Oh, why is a C model so hard to get off? No more pitch. Gently! Sixty-three hundred rpm. Six inches. Fly, dammit, fly! It's shuddering. It's into translational lift. We're flying!

How beautiful it had been. What power he had held in his hands. What freedom he had felt. He was Eddie Rickenbacker and Dick Bong and Colin Kelly. He was everyone who had gone forth to do battle in the skies. He was young and confident and proficient at his business. Why shouldn't he have felt flushed with excitement at the anticipation of coming combat? He hadn't really been afraid. There was just a healthy acknowledgement of danger that made his adrenalin flow.

The slicks had been at the rendezvous on time and he slid off their left flank as they turned final toward the LZ. He made a quick check of the formation, noting with satisfaction that both fire teams were in position on the flanks of the slick formation. He was in position to the left rear to augment the fire of A Team. He heard the scouting OH-23s report the LZ clear and no enemy contact. What a rotten job, scout-

MAJ Beyer, originator of the Horatio Frozzleforth stories which appear in the DIGEST, is currently serving his second tour of duty in the Republic of Vietnam. During his first tour, he was awarded the Silver Star, Air Medal with five Oak Leaf Clusters and Purple Heart. A graduate of Wayne State University, MAJ Beyer is dual rated and recently completed U-21 training at the U. S. Army Aviation School

Skids brushing the tops of trees, slicks and guns bore on. This was a piece of cake

ing in OH-23s. He sure didn't envy those pilots, but he admired their courage. Okay you guys, get your tinker toys out of the LZ so my guns don't shoot you up. You've done your job. Bug off and leave the fighting to the big boys.

The Ravens had gone and the LZ loomed ahead. Skids brushing the tops of the trees, slicks and guns together bore on. The slicks began to slip behind as they started decelerating. Ahead of him, numbers two and three had completed their firing passes. "Thump, thump, thump" spat his M-5 as the copilot walked a line of 40 millimeter grenades up the tree line to the left. Nice shooting, Dwight. That'll make them keep their heads down. As the end of the clearing flashed underneath, he broke hard left, eased in back pressure on the cyclic and pulled in power. The 540 performed as advertised. It was a steep, tight turn, 70 degrees of bank and g forces enough to push him firmly into the armored seat. The doorgunner was firing now and he caught a glimpse of Bushwacker Two through the green plexiglas, firing its machineguns on its second pass into the tree line behind him. Behind it, number three was lined up for its second pass.

He'd held it flat out as he raced downwind to be in position for a second pass before number three broke left. Another hard left turn and he was on final again. Number three was finishing its run. The slicks had cleared the LZ and were moving off in tight formation. He'd been glad the slicks knew their business. This was a piece of cake.

"Bushwacker Four, fire from 3 o'clock. Smoke's out."

"This is Bushwacker Five. Four is down in the trees. I'm covering him."

He made his decision quickly. Go to the aid of Four and Five. As platoon leader, his place was in the thick of things. Around the end of the LZ he had flown, and into what had been the daisy chain of his second fire team.

"Five, what is Four's position relative to his smoke?"

"He's about 200 meters southeast of the red smoke."

He hadn't been able to spot the wreckage underneath and knew he must before he could fire into the area. Without warning, the 100-foot trees that he had been just skimming were gone and he was over a clearing. It wasn't very big, not 300 meters across. But, during the few seconds that it took him to cross it, he was exposed 100 feet above the terrain, naked and vulnerable, stripped of his best protection, the nap of the earth. Those few seconds had seemed an eternity. There were men down there, little men scurrying across the clearing. Not our crunchies, they were still 1,000 meters south. "Thump, thump, thump," the M-5 had spat out its lethal message. Just a few seconds more and he'd be back over the protection of the trees.

Suddenly, a convulsive shudder ran the length of the Huey. The instrument panel disintegrated in a shower of shattered glass and wisps of acrid smoke rose from under the copilot's seat. From the corner of his eye, he saw the first finger of yellow-orange flame creep through the cargo door. Fire! Could he make it to the LZ? Perhaps — there was nowhere else to go. A hard left turn. It would be straight in with a quartering tailwind. They might just make it.

"Bushwacker Six, you're on fire. Get it on the ground."

"Roger, I'm going to try to make the LZ."

He'd been amazed at the calm sound of his voice. There was no betrayal of the tension and fear that filled him. The cargo compartment was a raging inferno. The gunner and crewchief were being roasted alive. He felt the intense heat on the back of his neck. Slowly, an arm of flame reached over his left shoulder, like the tentacle of a huge octopus. As if to pull him into the creature's great parrot beak, it began to engulf his head. Then, as deliberately as it had come, the fiery tentacle withdrew, leaving a searing pain on the back of his neck.

With a suddenness that flung him against the side of the seat, the stricken ship spun to the right and pitched up as the tail rotor and part of the tail boom burned off. The sudden spinning and resulting rush of air through the open cargo doors had blown out the fire, at least temporarily. But it ended their last chance of making the LZ. Now, only the trees were left.

There was no time for more than instinctive actions — actions from the long hours of training in the idiot circle at Ft. Wolters, of more than 2,000 hours of flying time and the years of accumulation of air sense. Pitch down, throttle to flight idle, nose down to try to salvage some airspeed. Hell, it had dropped to 40. Rotor in the green, gas producer at 35 percent and decreasing. So what? He didn't need the damned engine now anyway. He remembered a piece of advice he had heard once. "No matter what, keep flying it. Fly it all the way until it stops. Don't give it up." They were all dead men, but he'd at least go out fighting.

The time from tail rotor failure until they hit the

trees was only seconds. But the human mind is a strange thing when it faces the prospect of imminent death. In those microseconds, he thought of his wife and their three children and wondered how they'd take the news. Hard, probably. Dear God, take care of them. What would it feel like to die? What was to come after death? He had always had a strong belief in God and in an afterlife and this gave him some comfort. At first he had been terribly afraid. But now, in what he believed to be the last seconds of his life, he was amazingly calm and unafraid.

Even as these thoughts filled his mind, he still fought desperately with the crippled ship. If, at the last instant, there was no other place but those terrible trees, he'd go in tail first, put as much airplane between the ground and the crew as possible, and use all of his rpm to stop the rate of descent before the main rotor hit the trees. But if there was the smallest clearing, he'd zero the airspeed and go in flat, using his rpm to slow the descent all the way to the ground, praying the rotor would stay on as it chewed into the treetops.

But the time for planning and thinking and praying was gone. The trees were just inches away when, like a miracle, he saw a thin spot in the jungle. Not a clearing. Just a spot where the trees were a little less dense and not quite so high. He flared to stop his forward speed, leveled the skids and waited while the ship began to descend vertically. The cabin was into the trees and the collective pitch was at the upper stop. He heard and felt the tearing and rending of his once sleek and beautiful ship. Then came the final crashing jolt. He felt as though a giant's great hand had tried to squash him down into his seat. He felt his spine compress. There had been one moment of blinding, white hot pain in his back and then cool darkness engulfed him as he sank into unconsciousness.

"Wake up, John! You'll be late for school if you don't get up this minute. Do you hear me, John?" His mother was calling him. He stirred, but didn't get up. It was so warm and comfortable there in his bed and he was so tired.

"John, will you please get up? It's after seven. Breakfast is almost ready." He could hear her moving about his room, laying out his clothes. How many years had she been dead now?

"John, for the last time, will you please get up?" In exasperation, she pulled back the heavy covers, allowing the searing hot air of the bedroom to engulf his body.

"John, get up!" Her voice was no longer coaxing. It was demanding. Then it was desperately pleading! "John, wake up, the airplane's on fire. Wake up!"

Suddenly, he was awake, fully and painfully awake. All about him raged the inferno. Thick black smoke choked his lungs. Near panic engulfed him as he desperately, vainly, struggled to free himself from the seat. After what seemed an eternity of fruitless struggle against the unseen forces which pinned him, he remembered, with self-contempt and anger, that his seat belt was still fastened. The realization of his own stupidity was the one thing needed to quell his panic. He began to function rationally again. He released

The night was hellish. They just lay there on the jungle floor waiting for death or rescue

the lap belt, pushed back against the sliding panel of armor plate with his right elbow and, as it slid back, said a little prayer of thanks that he had had all of the spring catches removed so the pilots could easily move the armor panel themselves. Then the door was open and he half leapt, half fell out into the cool sweet air of the Vietnamese jungle. He was able to crawl some five meters before he collapsed on his face, alternately retching and drinking in great gulps of fresh air.

As his strength returned, so did his senses. With a start, he remembered the rest of the crew. Slowly, painfully, he climbed to his feet and staggered back toward the blazing aircraft. He had to make sure they were all out. As he approached, the crewchief and gunner were nowhere to be seen. But, struggling to pull himself free from the copilot's seat, was Dwight. His face was ashen with fear and pain as he clawed at the door frame in an attempt to pull himself free. As fast as his own aching body would allow him, he moved to the left side of the gunship and found the copilot's right foot tightly wedged under the M-5 ammunition chute.

"Don't worry babe. I'll have you out of here in a minute," he'd heard himself say. But it was not a minute. It seemed like hours that he bent and pried and beat against the unyielding ammunition chute without success. The heat was intense and the smoke choked him. Just once, he allowed himself to glance aft toward the 17 rockets resting in the still attached pod. If just one went off, it would tear him to shreds. He mustn't let himself think of that. But he cursed himself for not jettisoning the external stores when it was obvious they were going to crash.

It was no use. The ammunition chute wasn't about to budge. He had to get away and save himself. He couldn't save Dwight. To stay and die with him made no sense at all. But he couldn't leave him to burn to death. Not to burn. Any way of dying was better than burning. His hand touched the .38 strapped to his hip. Why not? Just a quick stab of pain and it would be all over. Just a quick stab of pain compared to the agonies of feeling yourself consumed by the flames, of being roasted to a charred lump. Did he have the courage to do it? He loosened the strap on his holster.

Don't look at me that way, Dwight. Don't look at me with that pleading in your eyes. You think I'm going to leave you, but you're wrong. Dammit, don't look like a pleading puppy dog. What else can I do? He began to ease the pistol from the holster. Then it struck him. The look in Dwight's eyes wasn't pleading. It was trust. It was the look of complete faith that his commander and his friend was not going to fail him. He recoiled with horror. Oh, dear God! What was I thinking of? With a frenzy born of desperation and madness, his hands tore at the ammunition chute, straining, pulling. It moved. Not much, but it moved a little. Then it moved a little more and, with a final tug, the foot came free.

With Dwight's arms around his neck he strained backwards, pulling the copilot and his useless legs from the wreckage. But his own injured back could not support their combined weights and he fell. Slow-

He found two helmets to use as water buckets and set out to search for water. It was without doubt the worst decision he had ever made

ly, ever so slowly, he crawled away from the burning ship dragging Dwight's dead weight beneath him. Foot by agonizing foot, he crawled. He became aware of a movement in the jungle just ahead. He looked up to see his crewchief emerge from the bush, walking as if in a trance.

"Willard, come help me with Mr. Price." Specialist Willard turned and looked uncomprehendingly at the two struggling pilots.

"Willard, dammit, come help me."

Slowly, almost casually, the dazed crewchief walked over, bent down and began pulling at the shoulders of the paralyzed copilot. Between the two of them, they were able to drag him some 10 meters before the ammunition began to cook off.

At first it was just one round, then three, then ten. Then it was as if a major firefight were taking place. They dropped to the ground, he covering Dwight's body with his own. For what seemed an eternity, they lay there while 7.62 rounds filled the air, punctuated by occasional louder explosions of what must have been the 40 mm. Midway through the holocaust had come one much larger explosion. Rockets, he supposed, or the 40 mm ammunition box. They lay there pressing themselves into the ground, waiting for that hot searing pain which would mean a round or fragment had found one of them. The final explosion had come with such force that the breath was knocked from his body. Then it was quiet. Only the sounds of the jungle, the far-off battle and his own breathing could be heard.

The silence was shattered by the scream of an F-100 as it flashed just overhead on a firing pass. Hot brass fell all around them. As the F-100 pulled up, a single heavy machinegun opened fire. Probably the same antiaircraft gun that got me, he thought. Four more times the F-100 made its pass and four more times the machinegun opened fire as it pulled up.

Painfully, he pulled himself upright and began to take stock of their situation. He found the doorgunner five meters away, half conscious and delirious. He had several wounds, in the leg and face, but they were not serious. They had stopped bleeding. But his burns were serious — very serious. His face, neck, and arms (the product of rolled up sleeves) were burned and charred. Great flaps of skin hung loose, exposing the raw muscle beneath. He covered the worst of the burns as well as he could with pieces of undershirt. He wished desperately for some water with which to mix the burn powder from his first aid pouch. But their only water had been a gallon thermos jug which was now a melted blob of plastic somewhere in the crater that had once been a helicopter. Specialist Willard was also burned about the face and neck, but not so badly. He complained of severe back pain and it had been impossible to get him to move since he had dropped to the ground when the ammunition had started to go. Dwight was by far the most seriously hurt. He had no feeling from the waist down and could not move his legs. But he was conscious and in relatively good spirits.

Their stock of survival equipment was pitiously small. The gunner had grabbed the aircraft commander's M-16 as he abandoned the aircraft. Except for this weapon, they were defenseless. No one had been wearing his pistol, except himself, and his holster was now empty. The pistol had probably dropped out as they crawled away from the ship. He had meant to put an end to the practice of hanging personal weapons in the aircraft instead of wearing them, but hadn't gotten around to it. He cursed his laxness. No one had remembered to grab the aircraft survival kit or the precious URC-10 survival radio. There was nothing to be salvaged from the aircraft. Only the left skid and the M-5 turret remained of the once proud UH-1. All they had were the clothes on their backs, one M-16 with 40 rounds of ammunition, and the contents of two soap-dish survival kits which he had in his pockets.

The only thing to do was to stay at the crash site and wait to be found. The troop SOP called for it and common sense dictated it. Without so much as a compass, movement, even if they had all been able to travel, was out of the question. Yes, the answer was to stay put. Enough people had seen them go down. They'd be found soon. But found by whom? He shuddered.

The afternoon passed. They ate some of the candy from the survival kit, but it made them terribly thirsty. The delirious gunner begged for a drink. When told there was no water, he only begged again. Some distance away, the sound of battle could be heard. There were small arms fire, the sounds of mortars and artillery and the constant airstrikes. He thought the grunts must have run into a pretty good size NVA force.

Afternoon wore into twilight and he knew that rescue would not come until morning. He moved a a little to place himself and the M-16 between the

others and the most likely way the enemy would approach. The only thing they could do was wait and hope the NVA didn't come. And if they did, to fight like the devil — about 40 rounds worth.

The night was hellish. Artillery strikes fell around them within a few meters, it seemed. He heard the sounds of the fragments as they passed through the trees above their heads. Branches and twigs cut from the trees fell beside them. They pressed their bodies close to the earth for protection and comfort. Oh, for a hole to crawl into. But if they'd had tools, they hadn't the strength to dig. They just lay there on the jungle floor, waiting for rescue or death.

It was worse when the artillery stopped. While the shells were falling around them, he knew the enemy, too, was forced to lie flat or in their holes. Now the NVA could move at will through the jungle. His ears were alert to all the sounds about him. Was that someone moving through the underbrush, or just the sounds of the jungle? His hands were moist on the M-16. His eyes strained to see into the darkness. Was that a man? No, just a shadow.

Suddenly, a yellow-orange streak of light stabbed down from the sky, followed by the retching sound of a minigun. He became conscious of a droning above. Again the stab of light and the retching. Above him, in lazy circles, flew an old C-47. It was Puff. The stream of tracers crashed into the jungle. For what seemed hours the gooney bird orbited, pouring out thousands of rounds all around him.

Then Puff had gone and they were again alone in the silence. The gunner moaned and cried for water and for his mother. He kept talking quietly to him, hoping that the sound of his voice might somehow keep him from screaming, as he had twice before. What a helpless feeling to have absolutely nothing with which to ease his pain and delirium. He had never felt so utterly helpless and impotent.

Dawn came quietly. The sounds of battle were muted and far away. Then it was only the occasional crack of small arms fire. But no rescue came. He could not hear an airplane or a helicopter. His tongue was swollen in his mouth. He swore he'd sell his soul for just a sip of water. The gunner was sometimes conscious, but mostly not. His face was blooming grey and his breathing was labored and rapid. Willard seemed better, though his burns looked much worse than they had. Most of his exposed skin was covered with huge blisters and there were patches of charred blackness that plainly spelled third degree burns. He could move around, but only with considerable pain. Dwight seemed to be in excellent spirits. He still could not move or feel his legs, but he was alert and actively engaged in ripping apart a flak vest.

"The white nylon inside will make good signal panels if someone should fly over our miniclearing. It won't be the best, but it's better than nothing," he had replied when questioned about his work.

As the morning wore on, it became obvious that rescue was not going to come immediately and they would have to take some action to survive. Water was the most pressing problem. It had been 24 hours since any of them had had a drink and they were becoming dehydrated, especially the burned gunner and crewchief.

He made his decision to set out in search of water. The area was covered with streams and it couldn't be too far to one. It would be risky. Not only was there the risk of running into NVA but, without a compass or map, the risk of getting lost. He estimated that if he walked straight downhill until he found water, then straight back uphill, he should be able to relocate the crash scene. He found two of their four flying helmets to use as water buckets. The M-16 would stay with the rest of the crew. It was better for three to have some protection than one. Besides, his hands would be occupied with the helmets.

He explained to Dwight what he was going to do and set out into the jungle. It was without doubt the worst decision he had ever made. The jungle was thicker than anything he had ever imagined in his worst nightmares. Vines clung to him. Thorns tore at his body. It was impossible to head straight downhill because the patches of undergrowth that were too dense to be penetrated had to be circumnavigated. He lost count of the number of times he fell. Each time he hauled himself to his feet, the pain in his back became more intense. It took him more than 30 minutes to reach a small stream. It was small, but clear, fast flowing and cold. Forgetting all that he had learned about water purification, he lay flat on the bank and drank until he could drink no more. Then, filling the helmets, he started the torturous trip back.

After two hours of walking, he was forced to admit that he was hopelessly lost. He had no idea which way to go to find the downed helicopter. He felt panic welling up. He wanted to run and cry for help. It didn't matter that he didn't know which way to run

After 2 hours of walking, he was forced to admit he was hopelessly lost

or that there was no one to hear his cries, except the NVA. But there was nothing else to do.

Get a grip on yourself! Don't panic! It's all over if you do. He fought the panic with all the will he could command. He remembered when he was a Boy Scout years ago, that someone had told him if he was ever lost in the woods to just sit down on a stump and relax and try to calmly figure out what to do. So he did just that. Only it was a log and not a stump. He sat and forced himself to be calm. He forced himself to forget his fear and pain and to look about the rain forest. Patches of warm sunshine penetrated the cool shade. There were brightly colored flowers and berries among the deep green foliage. He might eat some of those berries. Far off he could still hear the occasional sounds of war. Closer, the birds sang and small things moved in the brush. It was very beautiful, peaceful and quiet — except for the chain saw that disturbed the stillness.

Chain saw? Did he really hear a chain saw? There was no doubt about it. And a chain saw meant engineers and a U.S. unit. He was sure that Charlie didn't have chain saws. If he could just follow that sound, he'd find help. Once more he struggled to his feet. With renewed confidence and hope, he began painfully walking toward the sound.

He struggled through the elephant grass, driven mostly by willpower. His strength was almost gone.

Each step sent a sharp agony through his tortured back. His eyes were glazed with fatigue and pain. His intellect had ceased to function. Now it was instinct that kept him moving toward the sound of the chain saw. He stumbled and fell. Painfully he rose to his hands and knees. The helmets had long been dropped. Slowly, he pulled his aching body upright and resumed his staggering journey. Two more steps and he fell again. Again the agonizing process of getting up and staggering on, only to fall again. In some places the elephant grass was so thick he could not stand, but could only drag his body through it.

He'd make it. He hadn't come all this way not to make it. He'd made it through the crash that should have killed him, hadn't he? He'd survived the holocaust of ammunition cooking off and the night of terror, hadn't he? Well, he'd make it through this too. He had to. There were people waiting for him at home. His wife was waiting, and their children. His mother was waiting. No, she was dead. She wasn't waiting. Who else was waiting? Keep thinking about those people waiting for you. Your father, and your aunts and uncles, they were waiting. You've got to get home to see them, maybe for Christmas. No, your tour isn't up until next summer. Get home for a picnic on July 4th. That would be nice. Hot dogs and beer. Cold beer from a bottle and watermelon and a baseball game in the afternoon. Yes, that would be nice.

He either didn't see the bomb crater or his mind couldn't make his fatigued body avoid it. Down into it he plunged, rolling over and over. Blinding pain engulfed him. He lay still for a moment at the bottom of the crater and then began clawing upward, slowly, torturously, toward the sound of the chain saw. But he couldn't go on. His broken and exhausted body would not and could not respond. Tears of anger and frustration burned his eyes. He'd come so close. He'd almost made it. Sure, but close only counts in horseshoes. He'd been so damned close.

• • •

"What's that over there at 10 o'clock?"

The aircraft commander of the Chinook looked

He lay still for a moment and then began crawling upward, but he couldn't go on

where the pilot pointed. They, and every available aircraft in the battalion, had been out all day searching for the crews of the three gunships, two slicks and the AD-1 that had been zapped the day before. Man, that had been the king sized mess of all time.

"Over there, down in the bomb crater. It looks like a body."

"I think you're right. Looks like an American, too. Let's go see."

The Chinook made a tight descending turn and came to a low hover about the lip of the crater. A big man emerged from the belly hatch, made his way to the still form and lifted it, gently, in his arms. He passed it to waiting hands which pulled it, also gently, into the aircraft.

The big man briefly examined the body. "Tell the pilot," he said to a gunner, "that he's in pretty bad shape, but he's alive."

"Don't you worry, captain, we'll have you to a clearing station in no time. You'll be okay."

He tried to talk, but the sound wouldn't come out of his cracked lips. The big man bent close. "Crew," he croaked into the big man's ear, "three alive at the crash, all hurt."

"It's okay, captain. We got them two hours ago. An FAC spotted a big 'SOS' laid out on the ground. It was made out of panels from a flak vest."

All at once, the dam burst. The flood of emotions he had kept bottled up so tightly for so long gushed forth. Tears rolled down his cheeks and great choking sobs convulsed him. He wept unashamedly in relief and gratitude, until he could weep no more. His lips moved in soundless prayer of thanksgiving. Despite the noise of the transmission overhead, the vibrations, and the hardness of the deck on which he lay, he slept.

AUTHOR'S NOTE: *This story is a fictional account of a true survival ordeal which occurred in the Republic of Vietnam in 1966. It was a harrowing experience for the crew, one they will never forget. Lest we apply the axiom "All's well that ends well" to this story, we should examine it with an eye to learning from their experience so that, faced with similar problems, each of us may at least avoid some of the mistakes which could well have cost four lives.*

In line with this, some recommendations are in order which should be considered by every commander throughout the entire chain of command—from theater commander down to each and every aircraft commander. It should be pointed out that these recommendations are the authors based on his experience. They do not necessarily reflect the position of USABAAR, the USAAVNS or the Army.

First, in a serious crash, one in which the aircraft will be totally destroyed by fire, it is highly unlikely that anything which is not attached to the occupants will be removed from the aircraft. You cannot depend on any specific piece of equipment being removed. So those things which are vital to combat survival must be worn at all times by crewmembers. There is no excuse for all members of the crew not wearing their personal sidearms. Maybe they are a bit uncomfortable. But they're not worth a thing if they're hanging on the back of the armored seat when the aircraft is burning.

The new leg style survival kit solves many problems associated with survival kits. But it must be worn to be of value. If the new kits aren't available, then units should take it upon themselves to jury rig kits, one to each aircraft, which can be worn habitually by the same crewmember, say the pilot. Likewise,

some sort of halter, harness or pouch should be locally produced so that the survival radio can be worn by someone, perhaps the aircraft commander. The key to all of this is the word "worn", because everyone's first reaction after a crash is to get the people out and only after that to get equipment out. If the people are attached to the survival equipment, it comes out of the wreckage too.

What about water? Granted, it's virtually impossible for either pilot or copilot to wear a canteen. But why can't the crewchief and gunner wear one? No reason! They can and should. They can still do their jobs while wearing canteens. Sure, it's uncomfortable and causes a bruise on the hip. But what's most important? And those canteens have to be full to be of any value. So we'll still wash down the noon "Cs" with Kool-Aid from that everpresent Thermos jug.

That brings us to the subject of crash drills. When was the last time you, or anyone in your unit, conducted one? Who is supposed to grab that Thermos? Who polices up the M-16s? Who counts noses and where do you assemble for the nose count? Who is responsible for seeing that the guy who is pinned in gets out? Who grabs that big aircraft survival kit, if you've got one? If you, and every crewmember who is going to get in the airplane with you, has the answers to these questions, you don't need crash drills. More likely, you've been conducting them regularly.

And what about flying with your sleeves rolled up? How many years have we heard about this old buga-boo? It's simply a matter of command emphasis and discipline.

Every crewmember ought to invest two bucks in a small, compact compass and it ought to be in his pocket every time he sets foot in an airplane. It's second in importance only to your personal weapon during a combat survival situation. How many of us have them? Too few. Believe me, without a compass in the jungle you don't know anything.

The question of leaving the crash site should be answered automatically. Don't ever leave it — well hardly ever. Ninety-nine times out of 100, your best chance is to remain with the aircraft. Of course there may be vital reasons to leave, such as the presence of the enemy or a desperate need for — as in this story's example — water. If you must leave the crash scene and you want to return to it, take plenty of precautions. Terrain navigation in close country is virtually impossible. Working off a compass azimuth is little better unless you're a Ranger and have met your semi-annual and annual worm eating minimums. A better idea would be to blaze a trail like a Boy Scout or drop crumbs á la Hansel and Gretel. But anything's better than just striking out through the woods trusting to luck.

That sliding armor plate on the outboard side of pilots' and copilots' seats is a potential hazard in a crash. The latch is almost impossible to reach from the seat and, with the plate forward, exit from the aircraft is also almost impossible. The "T" handle latch can be easily removed and just the weight of the plate will hold it in position. Then either pilot can make his exit space with just a push of his elbow. And he should be made to move it himself during normal operations for practice. The little courtesy of the crewchief or gunner always sliding back the plate may one day cost the pilot his life.

Last, and by far most important, is the will to survive. There is absolutely nothing in a survival situation which can take the place of the will to survive, the determination to overcome even the most formidable of difficulties. Postcrash survival, when rescue is not accomplished within a few hours, is always trying. In a combat environment it is infinitely more so. Injuries, fear, lack of equipment — all combine to place the individual under extreme stress. This stress can easily lead to panic or lethargy if not actively fought. And it can be fought only by self-discipline, by making yourself do those things and think those thoughts which will assist and not hinder the business of surviving. It is not an easy thing to do. Panic can be so close beneath the surface that very little is required to trigger it. But it can be done. Discipline is a funny thing. The man who is self-disciplined in little things will find that it carries over when the chips are really down.

Barring massive quantities of luck, the outcome of most survival experiences is usually determined long before the crash. It is determined by the preparation of the crew, both mental and equipment preparation. The "it can't happen to me so I won't think about it" attitude has no place in Army aviation. It can happen to any of us. And each of us must be prepared to face it if it happens. A little preplanning, a little training, a little preparation just might make all the difference between making it or being one more KIA. Fly every flight as if you expect it to end in a crash. If it doesn't, you're just that much ahead of the game. If it does, you're still ahead of the game — way ahead.

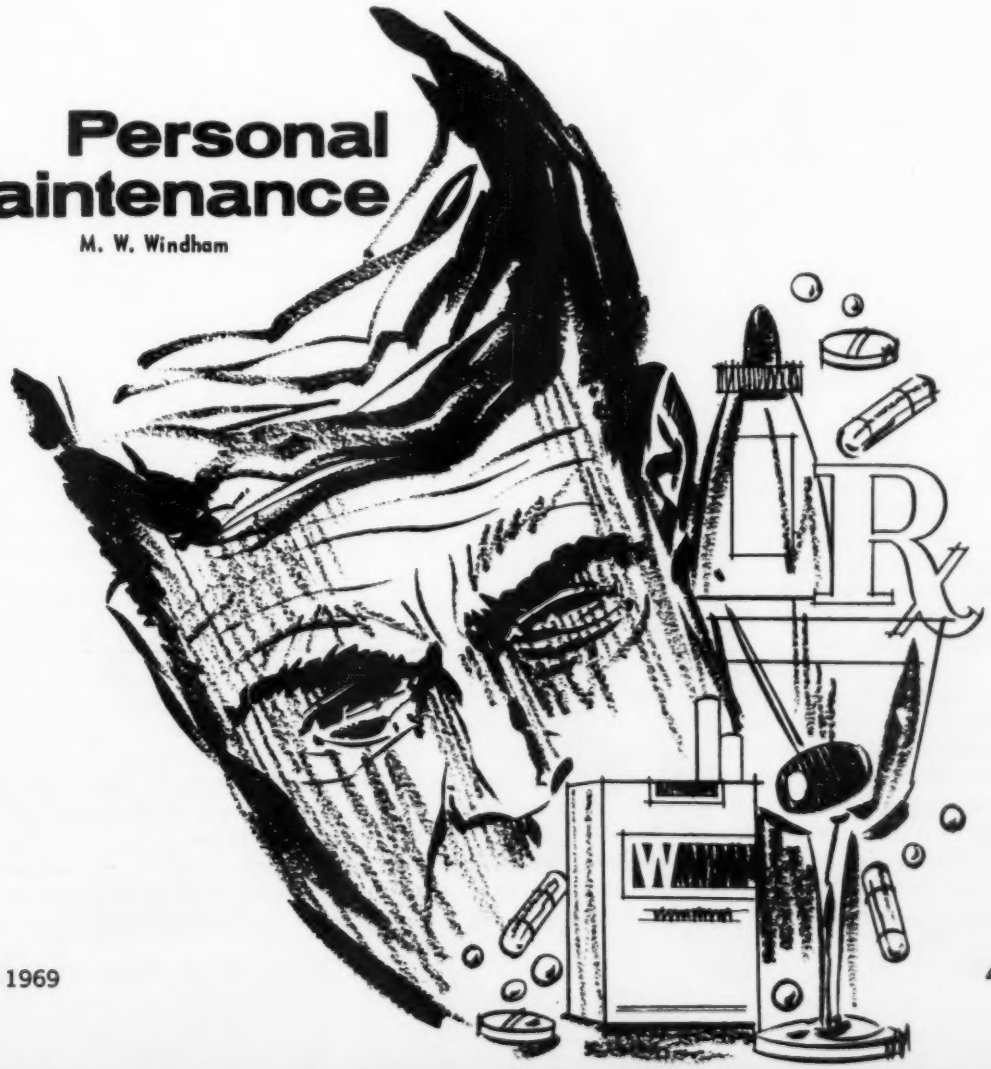
Personal Maintenance

M. W. Windham

PERSONAL MAINTENANCE should be no less important to you than the maintenance your aircraft receives. Ignoring your physical condition can prove as dangerous as ignoring your preflight. Medical authorities agree that eight hours of sleep is required for the average person. Some need more and a few can get along with less. If you think you are among those few, look out. The same authorities say even a slight reduction in required sleep, as little as two hours, can impair mental functions, with no physical clues.

A U-6 pilot thought a couple of hours of sleep would be enough for a 12 to 15 hour flight. "I got up at 2230 and felt quite rested." But he was far short of his destination when his fuel was exhausted and his aircraft crashed. He took off into known and forecast instrument weather without a rated copilot. He took off with an overgross load and failed to compute his fuel consumption. When he realized he was running low on fuel, he requested weather at various stations, all ahead of him. Although the pilot stated he planned to RON when he became tired, none of his passengers knew this. They understood they were to fly all the way, stopping only for fuel.

A UH-1 crashed into the slope of a 2,000-foot hill, killing the crew of four and six passengers. The pilot and copilot were known to be up at 0130 the night before and possibly didn't get to bed before 0300. The most sleep they could have had was five hours and it could have been as little as 3½ hours. The accident investigation board stated: "The possibility of fatigue certainly existed and sleep deprivation was present." They had been on duty for 11 continuous hours at the time of the crash and had flown an estimated three hours.



An aviator's fatigue is out of proportion to the physical labor he performs. Planning and executing a flight of several hours is more fatiguing than a desk worker's entire day. Sleep is the oil that lubricates your mental processes and the fluid that keeps your servos going. Shortchange yourself on sleep and you risk a mental slowdown and servo failure.

FUEL

Do you eat a good breakfast before beginning your day's work, or do you settle for a doughnut and a cup of coffee? You need a well balanced meal, whether your day begins at 0600 or 1500.

An OH-23 pilot landed down a slope and the helicopter hit tail low on the left skid. It bounced forward several feet, hit the ground again and rolled forward. The pilot applied full aft cyclic and the main rotor blades chopped off the tailboom. His 759 showed 9.1 first pilot flying hours for the day of the accident — all after a night of no sleep, and all on a can of peaches, three cookies, and a nickel cake. He started his first mission before daylight without any breakfast.

Another pilot attempted to take off with his right skid tied down, resulting in a destroyed helicopter. He had completed his final mission and was anxious to return to his home base for the night. He had slept three hours the night before, with five to six hours of flying in the 16-hour period he had been awake after so little rest. He had one C ration during this entire period. Nightfall was approaching and it was extremely cold. It is evident that these factors — a fatigued pilot, possibly with hypoglycemia (low blood sugar), doubtlessly very cold and very anxious to get home for the night could have influenced the decision to "kick the tire and light the fire."

Small amounts of food taken frequently are more satisfactory in avoiding fatigue than taking large amounts at one time. If you're going to diet, do so only under your flight surgeon's supervision. Drastic crash diets have been reported as cause factors in aircraft accidents.

EXERCISE

There's no substitute for exercise. It helps to relieve nervous tension and mental fatigue. Once accustomed to regular exercise, you quickly realize how much better you feel because of it. Some flight surgeons recommend a good night's sleep between physical recreation and flying.

Static fatigue, which produces changes in body chemistry, and is caused by doing almost nothing, can be overcome by exercise. Try wiggling your toes and feet inside your shoes. Then try pitting one muscle against another, like trying to bend your elbow and straighten it at the same time. This should help relax tense muscles.

ALCOHOL

No one likes to be lectured about booze. But take the case of an OH-13 pilot who thought he could hover after consuming six double martinis and several beers. He had to be pulled from the wreckage. Eight hours of sleep would not have been enough for this pilot. The alcohol might have been oxidized, but his body would have just begun to repair the damage it had sustained. Alcohol quickly impairs judgment and muscular control, even in small quantities.

SMOKING

If you haven't already stopped entirely, cut down on cigarettes just before and during flights. Most pilots don't realize that tobacco acts in a way similar to alcohol, as far as vision is concerned. Smoking just three cigarettes in a relatively short period just before takeoff will reduce your night vision as much as 8,000 feet of altitude. Nicotine also increases your nervous instability and tires your mental processes.

ILLNESS

Do you sometimes feel you're not up to par and really shouldn't be flying? Don't try to minimize your illnesses. An AH-1G pilot allowed his aircraft to strike the tops of several trees. Control could not be regained and the AH-1 crashed. The accident investigation board concluded that the pilot did not properly divide his attention between the instruments and gauges inside the cockpit and the relationship of the aircraft with the ground, allowing it to maintain a constant rate of descent without his knowledge. Rain on the canopy hindered the pilot's visual reference and forced operation at low altitudes. Pilot fatigue and a common cold were listed as contributing factors. The board stated that the pilot's ability to remain alert was reduced considerably due to an extended duty period, while contending with a common cold.

Minor illnesses which do not interfere with your activities on the ground can seriously handicap you in the air. Your flight surgeon is always willing to give you the benefit of his skill. If you don't feel well, see him. And never take medications unless he prescribes them. Many drugs, such as patented cold preparations, have side effects.

Flying demands mental and physical alertness every minute you are in the air. Adequate sleep, a balanced diet, regular exercise, prompt and professional attention to minor illnesses and common sense rules about drinking and smoking will make you a better and safer flier.

PEARL'S

Personal Equipment and Rescue/Survival Lowdown

A UH-1C, LOADED with 1,000 pounds of fuel, 14 rockets, 4,000 rounds of minigun ammunition and five persons aboard, took off for an armed reconnaissance of a valley. During takeoff the rpm went from 6700 to 6100. The flight continued and the reconnaissance was started.

At the upper end of a steep ravine, one doorgunner spotted an enemy soldier. At this time, rpm was again lost from 6700 to 6100 due to the terrain in proximity of tall trees. The aircraft was turned left, then back up the ravine to engage the target.

At low airspeed (40 knots) and maximum power (96 percent), rpm was again lost. Faced with the choice of going straight in or attempting another turn down the ravine, the pilot elected to land straight ahead. The helicopter landed on the side of the ravine, slid approximately 10 feet, then tipped over on its left side into a small stream bed. At impact, the left doorgunner, who had either failed to buckle or had unfastened his seat belt, was thrown out and pinned under the helicopter as it slid and rolled into the stream bed. He was killed. The other four crewmen, all strapped in, sustained only minor cuts and bruises. The gunner who was killed was wearing a monkey harness which, without his safety belt, allowed him to be thrown from the helicopter, but not clear of it.

A UH-1D, with a crew of four and three passengers aboard, was taking off from an LZ. The pilot made a hover check, backed to the rear limit of the long axis of the area, and took off into the wind. At approximately 15 feet, he banked to the left to avoid a barrier of 40- to 60-foot trees. As he banked, the tail rotor struck a dead tree. The helicopter spun to the right, shearing the tail boom on another tree and throwing two of the three passengers out. It continued its spin to the ground, impacted and was destroyed. None of the four crewmembers or the passenger who remained aboard were injured. One passenger who was thrown out had a spinal injury and the other sustained abdominal contusions. The report stated: ". . . The passengers would probably have escaped injury had they been secured and not thrown out on initial impact."

If you have a question about personal equipment or rescue and survival gear, write Pearl, U. S. Army Board for Aviation Accident Research, Ft. Rucker, Ala. 36360

The first of a five-part series of Bird Dog Classics which were first published in the AVIATION DIGEST during 1958 has appeared recently in several publications under the title "Once A Knight Is Enough." More than 10 years have passed and the need for directional control lessons is still evidenced by ground loop accidents. For those who enjoyed "Once A Knight Is Enough," here are the other four Bird Dog Classics.

Bird Dog Classics

Pierce Wiggin

BIRD DOG CLASSIC — II. And it happened that in ancient days, there chanced to be a young page who was considered the most normal man in the kingdom. All manner of folk gainsayed him thus. And it came to pass that when he had met the test and had risen to knighthood, he was called Sir Normal. For such was the way in that day.

Sir Normal was assigned to the Bird Dog Brigade of His Majesty's Flying Artillery. He applied himself diligently and earnestly strove to become proficient in the ways of his craft. And it came to pass that when he had mastered the maneuvers of the beast and was filled with the confidence of his youth, he descended from the heights, having it in mind to return the Bird Dog to the stables.

The confident knight made a normal approach on a left base leg for alighting to the north. It chanced that the wind was calm on that day and he lowered 45 degrees of flaps, the better to lower the alighting speed of the craft.

The Bird Dog lit in a normal manner, with the knight in complete command. It traveled straight down the alighting path for the distance of a strong arrow shot (400 feet). After traveling three-quarters of this distance, the knight noticed that all was not well with the tail of the craft; it seemed suddenly light. He pulled aft on the controlling stick and the Bird Dog began to turn to the starboard. Sir Normal engaged full left stirrup, but the craft continued to turn and began to skip lightly over the sod. The left wing dipped to the surface and scraped itself thereon, while the right foreleg broke at the hip. The Bird Dog stumbled to a swirling stop.

And the gray beards came in a mournful fashion to examine the broken craft and read the signs on the turf. And when they had finished, they called upon the knight and spake in this manner:

"Whyfore didst thou not have the controlling stick back to prevent the lightness of thy tail from the moment of alighting?"

"What caused thee to fail in the use of the brake?"

"Why didst thou not use the power, for such is the way of torque that it will aid in the stopping of a starboard turn?"

"Why didst thou not use a measure of down aileron on the outside of this turn, for surely drag was sorely needed in that place?"

"All these things have we asked thee, to no avail! The scribe has written for all to read and his scrolls

prove that the last portion of the alighting roll is no place to relax thy command of the craft."

"As sure as the horse needeth reins, thy Bird Dog needeth full directional control even until thou art ready to dismount!"

"Let not the *normal* approach nor the *normal* alighting lull thy senses. For it is written: 'Thy flight continues until the engine is silenced.' "

"Go and tell thy children, and thy children's children, lest they also stumble on this path."

And the gray beards raised their cups in unison. For they were very wise, and such was the custom in those days.

BIRD DOG CLASSIC — III. And there chanced to be a Knight of the Stirrup, Sir Heffie Foote, assigned to the Bird Dog Brigade of His Majesty's winged forces.

Sir Heffie was a warrior of great stature, known throughout the kingdom for his prowess with all the weapons of the royal arsenal. Alas, he was a terror to the Ladies of the Court. And when the fiddler played, these damsels fled in horror. For they knew full well the pain of trampled toes occasioned by the exuberant but clumsy dancing of the mighty knight.

Sir Heffie soared forth on a windy morning and whirled his Bird Dog through the sky, jousting merrily with a group of puffy cumuli. And when he had tired of the sport, he descended to alight. He dove the Dog beside the green turf and choked its roar, whistling softly to the earth.

The Bird Dog met the turf in good fashion; then it swerved to the right, back to the left, again to the right, and repeated to the left. A scream of pain issued from the Dog. Its forelegs locked into the sod, and the Dog bit its spinning nose into the grass, kicked its heels high into the air, and pivoted over on its back.

And those who observed the crash clanged the bell and brought forth the gray beards. These learned scholars examined the scars of the alighting path and regarded the injured Dog, listening the while to the angered roar from Sir Heffie. He swore loudly of locking brakes, until the youngest of the gray beards reached up and set the Dog's wheels spinning with a gentle touch.

The leader of the gray beards affixed his seal to a scroll and turned to the silent knight.

"The ways of thy feet are known, and the scars of the path tell the cause of this injury to thy craft.

"Thou has trampled thy stirrups without mercy to correct the errors of thy direction. And when thy direction was lost to thee, thou didst stand on thy stirrups and force thy Dog to bite this turf.

"Woe betide him whose heavy feet shall tramp the brakes of his craft in this fashion. It were a far better thing that thou hadst gently pressured thy brakes or used thy spur to soar forth and return again.

"It shall be recommended that thou dance on a bed of coals to teach thee a gentle touch with brakes and toes."

And the gray beards departed for they had been long away from their cups.

BIRD DOG CLASSIC — IV. And when the knight had flown far to reach his destination, he spake into a small black box, requesting of those who heard, a suitable path for alighting. And a voice spake into his ear, saying:

"Alight thee to the northwest and heed the wind which bloweth across that path from the port. Its velocity turns the leaf but doth not disturb the limb."

With this knowledge, the knight slowed his charger and dropped flaps to approximate the half of one right angle. He canted the craft to port and crabbed for a straight approach to the assigned path. Before he raised the nose, the knight removed all crab and lowered the port wing in a maner that kept the beast aligned with the path. And when the time came he brought it into a position that caused the left foreleg and tail to meet the turf in the same instant. All was well for this was indeed the manner written and talked of in all the kingdom.

THEN THE KNIGHT FORCED HIS STEED TO DROP ITS RIGHT FORELEG TO THE SOD!

As though to chase its tail, the charger began a turning to port that grew faster and faster. In great awe, the knight kicked right stirrup to the limit and engaged the brake in like manner; alas, it was to no avail. While the steed skidded over the sod its right foreleg folded beneath. The right wing crumpled into the ground while its mate rose higher in the air. And when its nose was pointing to the direction from whence it had come, the craft slid rearwards for five paces and slumped to a halt.

The shaken knight dismounted and looked longingly at the sky. For it were better that we were not found in that place. And he tore his hair and rent the air with curses, calling upon all to witness the weakness of the brake and rudder.

Before the dust had settled, the gray beards arrived; and one who was wiser than the rest tossed blades of grass into the air and watched their fall to earth. And when he had seen, he called to the others:

"Seek no more, the answer is plain! Heed not this talk of weak brake and full rudder, for these are blinds that hide the truth."

And when they were gathered about him, he spake in a voice of great wisdom:

"The ways of the bird are known and thy scrolls tell of this knowledge. Listen well, lest thou also forget!

"This knight was observed to have alighted his steed in the correct manner for the wind across this path. But then he forced the bird to lower its right foreleg. In this manner, by moving the controlling stick to the downwind position, the knight slew his correction for the port wind and all directional control was lost to him.

"Thy bird is like unto the weathercock, and when the wind doth blow, its tail will move downwind because of the broadness of its surface and the lightness of its weight. And when the wind is cross, thy upwind wing receives more air because thy downwind wing is blocked from a portion of its air by the upwind wing and the body of the bird. Thus, thy upwind wing doth produce more lift and drag than its mate and this would turn the bird. But this need not be, for thou dost hold in thine hand a full measure of correction. If thou holdest the controlling stick toward the wind, the aileron of thy downwind wing doth move downward and provide the drag that is greatly needed. In this manner, the aileron of thy upwind wing doth move upward to halt the lift and drag that is there. Heed well that as thy ground roll slows, the bird would more like to turn and a greater surface of aileron is sorely needed.

"Fear not for thy downwind leg remaining in the air, for as the bird doth cease to fly it will walk on all legs without thy aid."

And the gray beards called for their cups, for they were very wise and such was the custom in those days.

BIRD DOG CLASSIC — V. And revelry swelled over the green, for this was a time of great joy. Brightly colored silks swirled from the masts of every knight in the kingdom. Nobles and ladies, dandies and damsels, all pressed to the arena edge and shouted acclaim for each event in the Tournament of Knights.

The last jousting bout ended with the clanging fall of an unseated warrior. Trumpeters raised their horns and blew a mighty flourish. An expectant quiet fell over the crowd and the Tourney Master called out: "Knights of His Majesty's Bird Dog Brigade, mount for the Landings of Barrier!"

From the stables there came an angry noise as a covey of mighty Birds trundled forth and roared into the air. They formed an aerial pattern above the trees, following one behind the other.

Sir Stauling Bhounce, last to win his spurs in this elite group, eagerly peered down at the crowded turf and focused on the silken target panel beside the barrier. At the proper moment, he choked the noise from the Dog and gentled it downward. And when the panel had come to rest atop the barrier, Sir Stauling eased the controlling stick back and spurred the beast lightly to hold his target in place. All was well, and the good knight burned with pride at this chance to demonstrate his prowess before the king.

But hold! Could it be the panel had risen? Quickly, Sir Stauling pulled the spur, stared anxiously at the panel, and then sighed with relief when it began to sink again to the barrier.

The capricious god of the winds then dealt an evil blow. A gentle breeze, which wafted across the green, suddenly increased to a velocity that left the knight staring at the panel from below the barrier. No thought of aborting entered Sir Stauling's head as he reared the Dog's nose heavenward, thinking to climb above the barrier.

Alas, such was not to be. The Bird Dog struggled mightily, then lost its will and dropped toward the sod. Too late, the knight sank home the spur. When the craft struck, its noisy roar was heard above the crowd.

Both forelegs collapsed and the Dog's nose ploughed into the turf, showering divots all about.

Its wings folded downward and hid the knight from view. Mortally wounded, the Bird bounded upward, issued a last gasp, turned aside and crumpled to the earth. And a great silence came upon that place.

The gray beards were called forth. They measured the marks of the sod and regarded the broken Dog. And when they were finished, they trooped around the silent knight.

The eldest spake harshly, "Knowest thou not thy craft will cease to fly in such an attitude?

"Has thou not been instructed in the ways of thy angle of attack?

"Is the spur of such dreaded use that it should remain idle at such a time?

"Woe unto him whose foolish pride doth prevent a going again around!"

And while the sorrowing knight hung his head, the gray beards hurried back to their cups. For they were very wise.

STRESS RAISERS

Lieutenant Colonel Lester R. Kerfoot Jr.

AMONG AIRCRAFT accident investigators there is a well known story about a neat little lady from Brand X. The neat little lady worked in the rotor blade production portion of the Brand X helicopter manufacturing plant. As with many helicopter rotor blades, Brand X used a process of bonding the blade pockets to the rotor spar. In their process, bonding tape was placed on the trailing edge of the rotor blade spar and the blade pockets then firmly bonded to the spar.

During the manufacturing process, a small tag of the bonding tape was intentionally left on the inboard side of the number one pocket. To the neat little lady, this production method appeared untidy, so she decided to do something about it. A few days later, she brought a razor blade to work with her and proceeded to tidy up the blades by carefully trimming the unsightly bonding tape tags from the blades. In doing this, a fine-line razor cut was left in the rotor blade spars.

Several months after the tidied-up blades were put into service, a series of catastrophic and near-catastrophic accidents occurred in which certain model and series Brand X helicopters lost their main rotor blades. Investigators found that the blades had failed in fatigue, and traced the origin of the fatigue to a notch type stress raiser in the spar. Pursuing the

cause factor further, they discovered the neat little lady still trimming the bonding tape, still making a hairline cut in the blade spar, and still inducing stress raisers into the rotor blade spars.

FATIGUE

Generally speaking, there are three operating conditions required to produce fatigue in metals. They are:

1. Cyclic loading (on-off or push-pull type loads).
2. Tension type stresses.
3. Stress above the endurance limit of the metal.

When a part or component is subjected to repeated loads, stresses are created within that part. Although these loads are well below the static yield or failure point of the metal, the constant repetition of the load may cause the part to fail progressively in fatigue. Of course, the higher the load, the less cycles are required to produce the failure, and conversely, the lower the load, the more cycles are required to produce the same failure. As long as the loads are kept below the endurance limit of the particular metal, theoretically fatigue will never occur. The endurance limit is that point below which failure will not occur even with repeated cycles. It is determined experimentally for each material.

An example of this load-cycle relationship appears in a typical S-N diagram, where S equals the cyclic stress in pounds per square inch (psi) and N equals the number of cycles required to produce the failure. From an S-N diagram, it can readily be seen that the number of cycles required to produce a fatigue failure often extends into the millions and even billions. Often, this number extends well beyond the predicted service life of a part or component. However, there are other facets which reduce the life of a part to an unacceptable time level. One such undesirable facet was initially introduced by our neat little lady and will be covered later.

FATIGUE FAILURE

The word *fatigue* is an unfortunate choice, as fatigue implies recovery after rest, but metal damaged by fatigue cannot be corrected by rest or time. The term does have legitimacy, however, because it also implies that the fracture starts only after a vast number of stress applications, as though the metal has finally tired of resisting fracture.

Following are the outstanding characteristics of a fatigue fracture that distinguish it from other kinds of failures:

- A great number of stress cycles or applications are required before there is any external or visible evidence of the beginning of a crack. The crack is never sudden, as with brittle failures. It has been estimated that microcracks occur at 5 to 10 percent of the fatigue life, and that macrocracks occur at 60 to 80 percent of the fatigue life.

IN AIRCRAFT STRUCTURES

• The intensity of stress that can cause failure may be far below, often less than half, the stress required to rupture the material by a single load application.

• If the stress is kept below the endurance limit, fatigue failure will not occur, no matter how many cycles are applied.

• The crack starts at a nucleus or focal point where the stress is highest and progresses slowly (see photo).

• The fracture surface is often so smooth it appears to be machine cut, with an entire absence of necking down or granular appearance, except for the final, ultimate failure of the remaining portion of the part. The surface normally shows propagation marks, stop and beach marks.

The starting point of a fatigue crack is extremely local (often microscopic) having the highest stress in the part. Such a point may be a scratch, pit, nick, notch, burr or the result of an overstress from a previous accident. These starting points are properly referred to as stress raisers or stress concentrations.

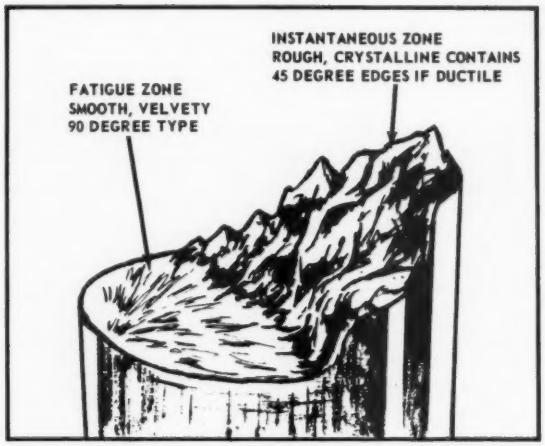
STRESS RAISERS

Stress raisers are defined as geometric forms, like notches, scratches, sharp shoulders, holes or inclusions, which cause a concentration of stress. They must be avoided if fatigue failures are to be prevented.

Various types of geometric forms provide different values of stress raisers. A round hole in a component, such as the incident bolt hole in the CH-47A blade socket, has the value of a factor of 3. This means that if the metal used in the blade socket has the tensile strength of 300,000 psi, then the hole in it reduces that strength *by* a factor of 3, or in this arbitrary example, to a strength of 100,000 psi. A rivet hole has exactly the same effect. All of this is calculated in the design of the part or component. It is so constructed and manufactured that it will provide all the strength required to perform its specified function (i.e., safely retain the rotor blade).

Looking at another type of stress raiser, we find that a notch has the value of a factor of 6. It was, geometrically and for the best definition, a notch that our neat little lady made in the rotor blade spars when she trimmed the bonding tape.

When stress raisers appear together they are not added, nor do they take the value of the highest one. Rather, their effect is a multiplication of their values. From this, we learn that when a notch appears in a hole, we do not have 3 plus 6, but 3 times 6, or 18. These types of stress raisers are seldom, if ever, designed, but can occur accidentally. They should be specifically avoided.



ORIGINS OF STRESS RAISERS

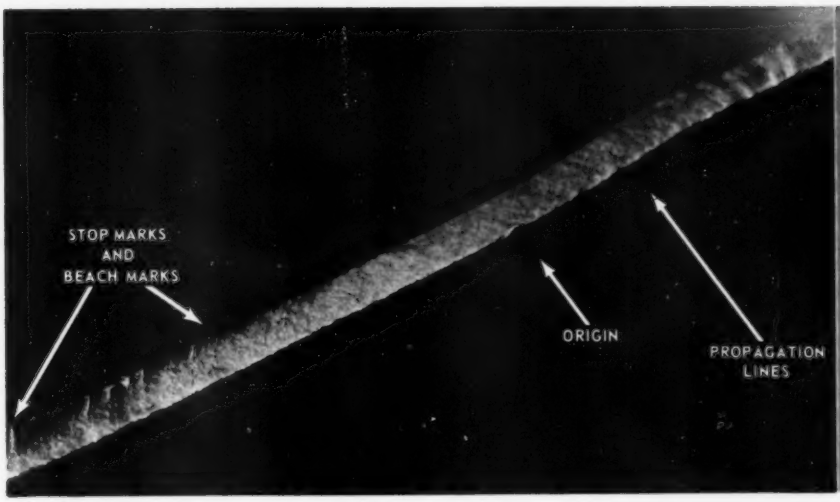
We have briefly spoken of stress raisers which originate with the designer. Additional examples of design-induced stress raisers include sharp changes of section or contour, such as fillets, thread roots, oil holes, keyways and splines. Most of these will also compute to be notches. However, we will discount all of these because, as stated before, the designer compensates for them in his design of the part or component.

Another class of stress raisers, also notches, results from processing and manufacturing and includes grinding marks and checks, grooves from machining operations, file marks, quenching cracks, seams, forging laps, burrs, etc. These can be avoided with careful quality control, pride in workmanship and skill. Different forms of corrosion (i.e., stress, hot, sulfate and intergranular) also create stress raisers. However, it is the operational side which is of more importance to us.

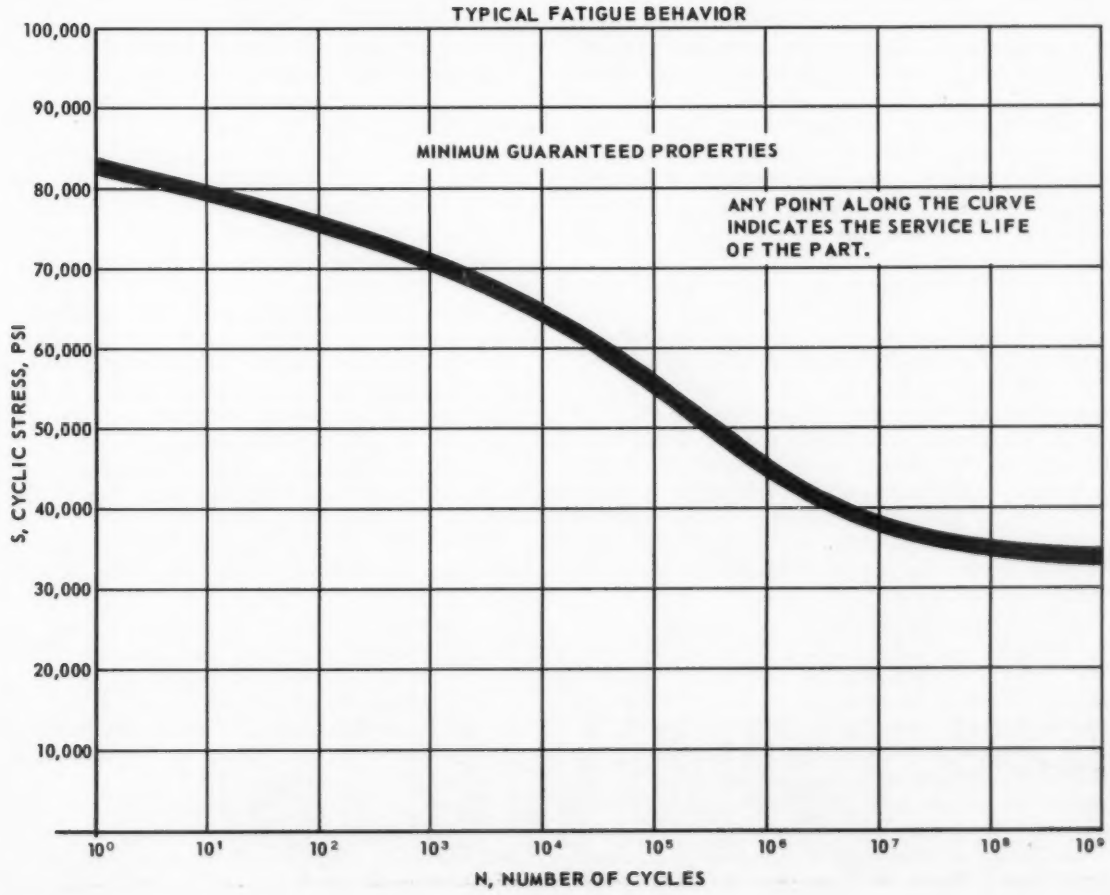
OPERATIONALLY INDUCED STRESS RAISERS

Operationally, in Army aircraft, stress raisers originate from two sources — the aviator and the mechanic. It is up to the mechanic, however, to reduce this problem. Typical of pilot-induced stress raisers are the nicks incurred on propeller blades from operating in unimproved areas. These specifically occur on 0-1 and U-6 aircraft. These nicks are true notches and have the same factoral value described above (a factor of 6).

When these notches are within the notch-depth per propeller station criteria set forth in the par-



Photograph of a fatigue failure in a main rotor blade spar. Note the propagation lines, stop marks and beach marks indicating the time duration over which the spar failed. Later analysis indicated that the fatigue propagated for a period of 40 to 80 flight hours



Pilot-induced stress raisers include such occurrences as an overstress of the airframe through exceeding the flight envelope, and overspeeds of the rotor system

Maintenance-induced stress raisers result from overtorquing bolts and the careless use of tools around critical airframe areas

ticular maintenance manual, it is up to the mechanic to *dress the notch.* This entails filing the nick down to a smooth and even contour. It must be remembered that file marks can also have the same effect as a stress raiser and such marks or cuts must also be smoothed and polished out. The result of smoothing out a nick in the propeller is to *flow* out the stress lines and reduce the area of the material to the near-original stress.

Other pilot-induced stress raisers include such occurrences as an overstress of the airframe through exceeding the flight envelope, and overspeeds of the rotor system. It is seldom that the pilot who actually overstressed the airframe or oversped the rotor system experiences the system failure. It is usually some innocent individual who follows him. The only way that these overstresses can be detected and corrected is through honest and accurate writeups by aircrews, and by very careful and thorough inspections by maintenance personnel. This is one reason why these types of occurrences *are not* considered accidents, as defined by AR 385-40.

Maintenance-induced stress raisers result from overtorquing bolts, thus causing an overstress in the bolt or in a casting and the careless use of tools around critical airframe areas. In the latter case, a pair of diagonal cutting pliers (dykes) is among the most common henchmen. When used to remove cotter pins, they are often used as a lever and braced against the aircraft part. In the case of the CH-47A incident bolt hole, such a cotter pin removal practice could induce a notch-type stress raiser in the bolt hole, thus a factor of 18 as described. Many instances of tail rotor failures, tail rotor gearbox separations and swashplate trunion failures in the UH-1, all in fatigue, have been directly attributed to improper maintenance procedures.

With all of its constantly rotating, moving, cyclically loaded components, the helicopter is a fatigue creating and producing machine, even without the services of a neat little lady. It is virtually impossible to avoid fatigue in helicopters. However, through constant observation of and adherence to proper operating, maintenance, and inspection procedures, fatigue failures can be prevented.

For those who would like to delve more deeply into this subject, the books in the following bibliography, used for this article, are recommended.

BIBLIOGRAPHY

1. Battalle Memorial Institute, *Prevention of the Failure of Metals Under Repeated Stress,* John Wiley and Sons, Inc., New York, 1941.

2. Doane, F. B., and Betz, C. E., *Principles of Magnaflux,* Magnaflux Corporation, Chicago, Ill., 1951.

3. Freudenthal, Alfred M., Editor, *Fatigue in Aircraft Structures,* Academic Press, Inc., New York, 1956.

4. Hurt, Hugh H., Jr., *Fundamentals of Aircraft and Missile Structures,* Air Science Associates of Southern California, University of Southern California, Los Angeles, Calif., 1960.

5. Rathbone, T. C., *Engineering Bulletin No. 6-47M,* "Failures in Metals, Causes and Prevention," The Continental Insurance Company, mimeographed, 21 July 1941, 14 pages.

THOSE BLOWING ROTORS

FEW WEEKLY accident summaries are published without at least one account of an Army helicopter damaged by rotorwash from another helicopter. To illustrate the magnitude of this problem, following are some of the briefs of accidents and incidents for a recent 18-month period.

As a training helicopter was being shut down with rotor rpm decreasing, another helicopter hovered by upwind and rotorwash caused a main rotor blade to flex and hit the tail boom.

An IP engaged the clutch of his training helicopter while another was hovering on an adjacent panel. Rotorwash from the hovering helicopter caused the main rotor blades to hit the tail boom.

Eleven more similar incidents, involving the same type aircraft, occurred during this period. All occurred during shutdown or clutch engagements while another helicopter was hovering nearby.

A UH-1D was damaged in like fashion when another helicopter hovered by as it was shutting down.

Another UH-1D was damaged by a hard landing when caught in the rotorwash of the lead helicopter during a formation landing.

A CH-47B was on the ground with its engines and rotors running when a second CH-47 hovered nearby. Rotorwash from the hovering CH-47 caused the rear of the helicopter on the ground to lift off. When the pilot placed the rear back on the ground, the ramp extensions dug in, damaging the fuselage.

Rotorwash from another helicopter caused a brass cartridge casing to fly into and damage the main rotor of an OH-6A.

A landing UH-1D was nosed up by rotorwash from another helicopter and hit hard on the left rear skid.

An OH-13S was approximately 6 feet above the ground when a UH-1D took off from its left front. Rotorwash moved the OH-13 to the right where its main rotor blades struck a large tree. The helicopter crashed and was destroyed.

Another OH-13S was shut down, with its main rotor still turning, when a UH-1D flew over it, causing a main rotor blade to flex into the tail boom.

A UH-1D, making a formation landing, entered rotorwash, dropped, hit the ground, bounced and crashed on its left side.

A landing OH-23G pilot lost visual contact in dust, put his helicopter on the ground and the tail rotor struck barrier wire. The dust was caused by rotorwash from UH-1Ds.

A UH-1D was refueling when a CH-47 hovered to drop its slingload. Debris was blown around the area and a sandbag was blown through the main rotor of the refueling UH-1D, damaging a main rotor blade.

An OH-13S landed to discharge a passenger. A UH-1D hovered by and its rotorwash blew metal particles into the tail rotor of the OH-13S.

A UH-1B followed five lift UH-1 helicopters into an LZ and rotorwash from the lift helicopters caused a hard landing and major damage.

An OH-13S had just been started when a UH-1D flew by and its rotorwash blew a piece of canvas into the tail rotor of the OH-13S.

A UH-1D was shutting down in a parking area when a CH-47 made a low, fast deceleration, rolling psp up into the UH-1D.

An OH-13S entered severe turbulence, resulting in a violent maneuver. Its bubble was shattered when a 30-pound ammunition can was thrown from the seat through the bubble. The most probable cause was an overflying CH-47.

A UH-1D, taking off in trail formation, was forced down into the trees when it entered rotorwash from the lead helicopter.

An OH-6A was being run up when rotorwash from a UH-1D in a nearby revetment caused a maintenance work stand to roll down an incline into the OH-6A, damaging four main rotor blades, the tail boom and drive train.

In all, 60 such accidents and incidents during this 18-month period accounted for aircraft damages exceeding $700,000. This needless waste can be prevented by **planning, by courtesy and by better housekeeping.** YOU can help!

COMMAND

Conflicting considerations influence the decisions as to where aircraft will land at fire support bases, pickup zones, and base camps. The purpose of this letter is to point out the primary considerations and establish responsibility for making decisions

LETTER

MANY CONDITIONS jeopardizing the safety of aircraft and the safety and well-being of ground personnel have been observed in the operation of aircraft at fire support bases, pickup zones and base camps. In November one CH-47, a radar set, six 105 mm howitzers and a large supply of ammunition were lost due to inadequately prepared landing zones, dangerous practices in the use of smoke in marking areas and lack of coordination. Conflicting considerations influence the decisions as to where aircraft will land. The purpose of this letter is to point out the primary considerations and to establish responsibilities for making decisions.

The supported commander usually desires loads (particularly large loads delivered by CH-47s or CH-54s) placed as close as possible to his troops or the point of use. He also prefers to have troops picked up or dropped at a location that requires minimum ground movement. The justification is minimizing the effort of his troops and security. In conflict with this desire is the damage to his installation and discomfort of his troops caused by the downwash of the aircraft and the blowing dust and debris. A hazardous situation which can result in serious injury to personnel on the ground frequently occurs.

The aircraft commander desires an operating area that is as free as possible of obstructions, with minimum dust conditions, clear of items that can be picked up by downwash and ingested by the engines or otherwise damage the aircraft and also with minimum personnel and vehicles moving on the ground. The aircraft commander shares the supported commander's concern for security.

Both the aircraft commander and the supported commander must constantly consider and minimize the adverse impact helicopter operations can have on the ground troops. A constant and justifiable complaint exists that life is made difficult for the ground troops at fire support bases by helicopters blowing dust into food and spreading debris and equipment.

It is the responsibility of the supported commander to provide a helicopter landing area of sufficient size, with safe approach and departure routes, adequately marked, free of materials which can be picked up by downwash and as free of dust as practical. The area will be a sufficient distance away from vulnerable equipment such as radar, tents, parked aircraft and refueling facilities to prevent possible damage. For tactical operations the above requires careful selection and organization of pickup zones and temporary resupply areas. For fire support bases, the above requires additional efforts to prepare and police suitable areas, including measures to reduce the dangers of dust.

It is the responsibility of the aircraft commander to be particularly observant of situations where the condition of the landing area may endanger his aircraft or personnel and equipment on the ground. Aircraft commanders will not land aircraft under situations considered by the aircraft commander to be hazardous, unless justified by the tactical situation.

The correction of unsafe conditions can frequently be made in a very short time by displacement of the landing area, removal of personnel or equipment from the immediate vicinity or policing of trash and loose items in the area. Aircraft commanders will advise supported commanders by radio when such actions are required prior to considering the area safe for the operation. Preplanning of all operations will include the necessary instructions on radio contact to assure coordination between the aircraft commander and the supported unit to effect coordination. Aircraft commanders will not land at a pickup area unless radio contact has been made with the supported unit.

USAASO Sez

The U. S. Army Aeronautical Service Office discusses

On Near Midair Collision Reporting: The Federal Aviation Administration has extended its "Near Midair Collision Study" through 31 Dec 69.

Pilots, controllers or other persons involved in near midair collisions are invited to report all such encounters to the FAA. To encourage reporting, the administration issued a policy statement which grants immunity from FAA enforcement or other adverse action to pilots, controllers or other persons involved in reported near midair collisions.

It is the Department of the Army policy to support this program. *Reporting Procedures:* Initial Report. Each person who wishes to report an occurrence as a near midair collision should notify an air traffic facility via radio: "I wish to report a NEAR MIDAIR COLLISION" and then give, provided frequency congestion permits, the:

(1) Time of incident.
(2) Location and altitude.
(3) Reporting aircraft's identification, type and destination.
(4) Available information on the other aircraft.
(5) Weather conditions.
(6) Approximate courses and flight altitudes of both aircraft.
(7) Closest proximity horizontally and vertically between aircraft.

NOTE: A written follow-up report should be submitted to an FAA Air Traffic of Flight Standards representative or mailed directly to FAA in Washington, D. C. The report should be made on FAA Form 8020-1 which is self-addressed to FAA in Washington, D. C. Operations officers should order these forms from:

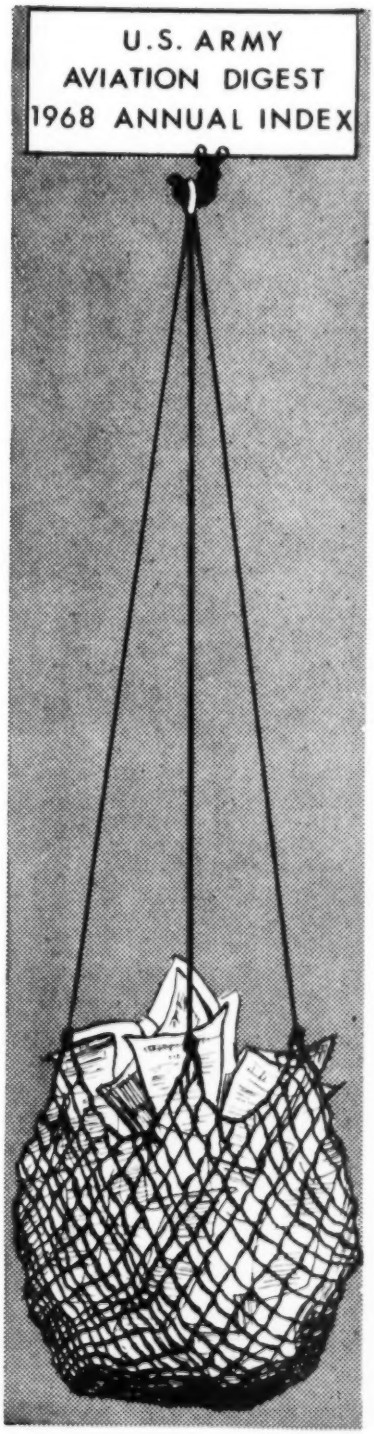
Department of Transportation
Federal Aviation Administration
Aeronautical Center
Distribution Section, AC-46.2
P. O. Box 25082
Oklahoma City, Okla. 73125

On FLIP Requirements: Find some of your stocks of FLIP items not being used? Coming up with a shortage of other items? You can remedy this situation by Selective Requisitioning, i.e., order what you need to accomplish your mission. For example: The operations officer of an Otter company located at Ft. Ord determines the majority of the unit's flights are within California with an occasional flight to Ft. Lewis and Ft. Bliss. He could order 16 Enroute Charts Numbers L1, L3 and L5, 16 Instrument Approach Procedures Volume 2, five of Volumes 1 and 3 and one or two of the remaining charts and IAP volumes for information purposes. The same rationale can be applied to other FLIP products. Selective Requisitioning means fewer packages and faster delivery. If you don't receive your FLIP documents at least one day prior to their effective date, check with your transportation office. If they don't have them, then call USAASO on Autovon 22-47773.

ALL IN ONE

ANNUAL INDEX NOW AVAILABLE

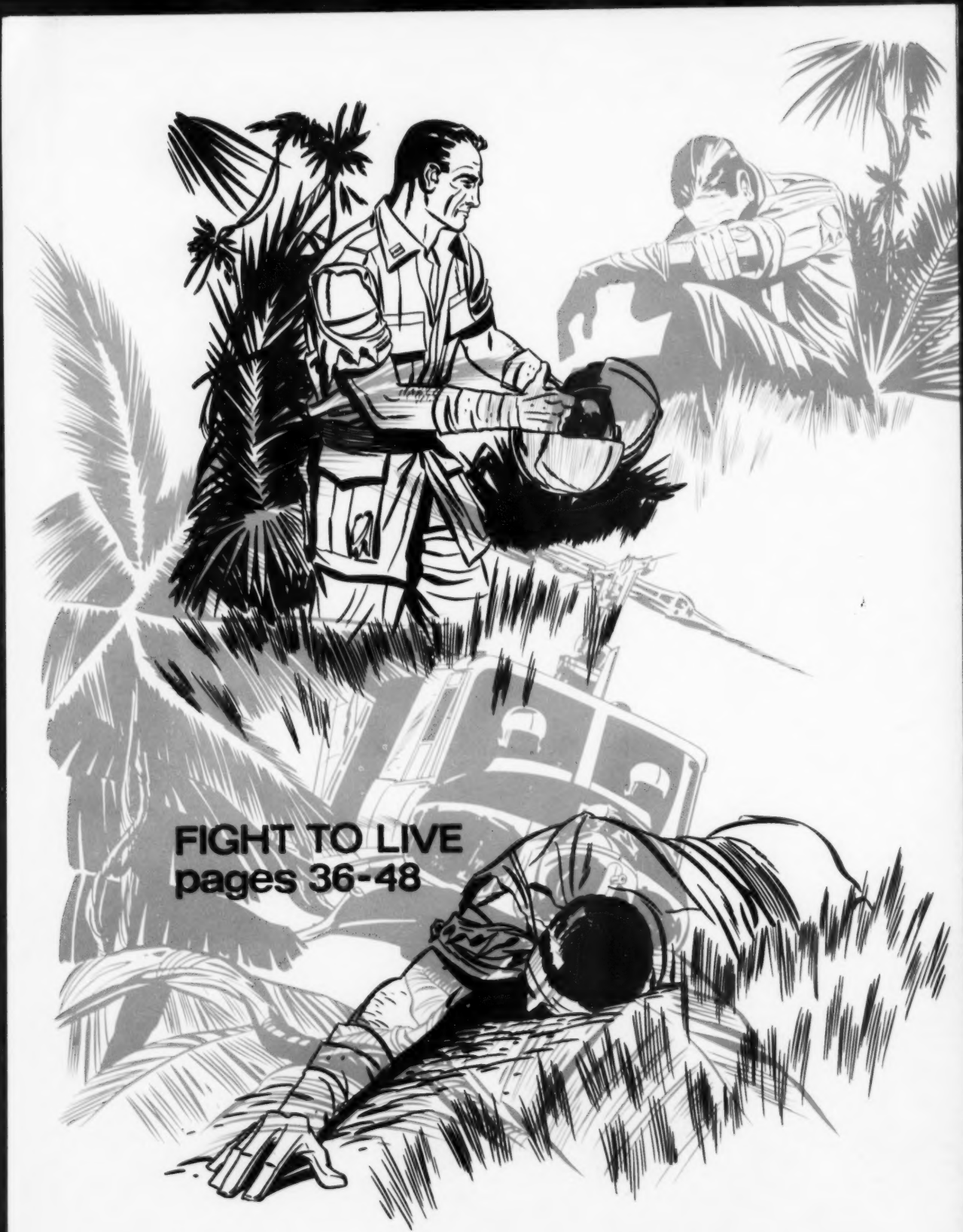
The 1967 and 68 Index of the U. S. ARMY AVIATION DIGEST is now available FREE for the asking. Each article has been divided into convenient groups making it possible for you to find what you want on any particular subject at a glance. To get yours write the Editor, U. S. ARMY AVIATION DIGEST, U. S. Army Aviation School, Ft. Rucker, Ala. 36360.



LOOKING FOR THE DIGEST?

Here's How You Get It

The U. S. ARMY AVIATION DIGEST is an official Department of the Army monthly publication for those having an interest in Army aviation. Active Army organizations get the DIGEST by submitting DA Form 12-4 to the AG Publications Center, 2800 Eastern Blvd., Baltimore, Md. 21220. Army National Guard units submit requests through their state adjutants general. Army Reserve units go through their chain of command to Army area headquarters. Air Force elements submit requests to HQ, U. S. Air Force (AFDASDC), Washington, D. C. 20330. Navy and Marine Corps units submit requests to Director, Navy Publications and Printing Service, Bldg 157, Third Floor, Washington Navy Yard, Washington, D. C. 20591. Coast Guard units submit requests to Commandant (CAM), U. S. Coast Guard, 1300 E. Street NW, Washington, D. C. 20591. Paid subscriptions are available from the Government Printing Office at $4.50 a year for mailing to a domestic or APO address and $5.50 to a foreign address. Make checks payable to the Superintendent of Documents and address requests to the Superintendent of Documents, GPO, Washington, D. C. 20402.


FIGHT TO LIVE
pages 36-48